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On the cover: The photo shows the QTH of Dick Sparling N2KEY on Chautauqua Lake, Bemus Point, NY.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is the page number on which the article or column starts as shown in the index.

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Contract: Merely exposing this page to your eyeballs consititutes a llegally binding contract between you and publiisher Green wherein you have agreed to get out of that rut you've been in, to shape up and put some adventure into your life. Thus you will, in 1996, open at least one new ham horizon, such as getting active on packet or get set up and start making satellite contacts. Further, you will document this adventure with a log and send a copy to publisher Green, and give a talk on your adventure to your local ham club, plus write a piece for the ham club newsletter.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Sunny Surprise

Astronomers at the California Institute of Technology have reported the first sunspot of the new cycle. Pause a moment for a round of cheers. They were surprised at the early start for Cycle 23. It's expected to peak around 1998, since the spots tend to build up rapidly and then fade away more slowly.

It'll be nice to have the HF bands open around the world again, and to be able to make contacts all night on 20m. During the better sunspot peaks even 6m opens up, allowing worldwide communications with low power. I remember one day when I tuned 6m with my pre-war Meissner FM tuner and heard the sixes and sevens boiling through. That sent me right to my workbench to build a 6m transmitter. Well, to convert a surplus SCR-522 rig to six.

Maybe you didn't know that the pre-war FM broadcast band went from 50-56 MHz, with us hams on five meters, 56-60 MHz. The two-and-a-half meter ham band went from 112-116 MHz. Well, mc, actually, since hertz hadn't been invented yet as a replacement for cycles per second. The SD radar on my submarine was on 112 mc, so I felt right at home. The main problem with that was that the Japanese quickly installed 112-MHz receivers in their planes so they could home in on our radar. That tended to discourage us from using it other than for an occasional quick blast.

The SJ radar, which was mainly for surface work, was up at 3,000 MHz, where the Japanese apparently hadn't figured out how to build receivers. So I used the SJ for spotting both ships and planes, and kept the SD off most of the time.

Back in 1949, I was one of the six meter pioneers. I was the only one on six in New York City. We were all crystal-controlled in those days, so I could tell the call letters of any signal, just by measuring its frequency with my surplus General Radio LR-1 frequency meter. Big sucker, with nearly a hundred tubes.

I got a 50.1-MHz crystal and set up a beacon so hams out West or in Europe would know when the band was open to my area. I made a code wheel out of aluminum, operating a microswitch to key the rig.

As the new sunspot cycle builds we're going to see DX coming back, so it's time to start planning your dream location, dream tower, dream beam and state-of-the-art ham station for late 1996. I've got the location, but I need some help in deciding what I should use for antennas.

In retrospect I can almost feel the angel wings brushing me when I tuned 6m and heard the pandemonium from out West. That got me on the air on six. And that got me to put on my beacon station. Then, along came Perry Ferrell with an Air Force contract to study 50-MHz propagation, so I helped him with my reception reports, plus the reception reports of my beacon. This was the Radio Amateur Scientific Observation project, RASO.

Perry awarded me a certificate for helping the project. Then, a couple years later, he became the editor of *CQ*. By then I was deep into RTTY. Perry liked my *Amateur Radio Frontiers* magazine and asked me to do a RTTY column for *CQ*. That helped generate more interest in RTTY, but more important, I got to be good friends with Perry, and knew he hated *CQ* publisher Sandy Cowan. So I helped Perry get the editor's job at *Popular Electronics*, since I knew the publishers, Bill Stocklin and Ollie Read. That led to me becoming the *CQ* editor, which I hadn't even considered before. Serendipity.

Adopt-A-Ham

I was reading in the Dayton club newsletter about the program set up by the Upper Valley Radio Club with Beavercreek's Brookwood Elementary School. They lined up four 9- and 10-year-old students to talk over the local repeater to each of seven club members. The aim wasn't primarily to get them interested in hamming, but rather to help the kids develop their ability to talk with people. That's called oral skills these days. However, two of the kids did get their tickets, and many previously inarticulate kids learned to talk freely with total strangers over the air.

Antenna Pruning

An article by W3HVS in the Port St. Lucie club newsletter reminded me that it's been years since I passed along a simple antenna pruning system. You can cut a half-wave dipole wire antenna exactly to the frequency you want with just one prune, if you do it right.

You start out with the half-wave formula of 468 divided by the frequency in MHz for the length in feet. Add on a foot or so, just in case. It's a lot easier to trim off a few inches than to add it if you come up short. The problem is that the length of your antenna depends to some degree on its height above ground, and how good the ground is under it.

Make it a little long and put it up into place. Now check for its resonant frequency. An antenna bridge is great here, but you can also just check for the frequency providing the lowest SWR. Now you can use a simple proportion of the length and the resulting resonant frequency to the desired frequency and the new length. Trim half of the difference off each end and you'll be all set.

You won't do a lot on 20m with a dipole, though my first sideband contact was with a 10-watt exciter and a twin-lead dipole thrown out of my window. I worked a VK and had a nice contact.

On 75m I've worked the world with a dipole. Everywhere. At the time I had a corking signal on 20m, but with the Sweepstakes Contest coming up the next day I knew I would have to have some 75m contacts during the hours when 20 was quiet, so I cut a twin-lead dipole and hung it slanted from my tower. The result was a whopping signal on 75, and contacts all the way out to Okinawa.

When I was visiting VK3ATN in Australia we worked W2NSD/1 on 20m. My signal was coming in S9+, so we decided to try 75 and see if we could make it. It was S9+ there too! I still haven't gotten over the excitement of that contact. Never will.

Pirate FM

Recently I wrote about a possible business opportunity for hams in setting up low-powered FM transmitters for private parties who'd like to be able to listen to their own music around their home. A chap in Berkeley has been carrying this to extremes with his Free Radio Berkeley (FRB). Steve Dunifer started out with a 5-watt rig and a 10-foot antenna, broadcasting three hours Sunday nights on an unused FM channel. The FCC naturally got after him, assessing him a $20,000 fine. Dunifer fought back with lawyers, demanding to get copies of the reports of interference, which the FCC had cited in their complaint.

When the FCC could produce nothing, Dunifer began making and selling micro-power FM transmitting kits, with the result that several hundred similar stations are now in operation around the country. Then, when a federal judge refused to back the FCC on constitutional grounds, he took FRB full-time from a permanent location, broadcasting 24 hours a day, complete with a call-in phone number and running about 40 watts.

Canada allows unlicensed micropower FM stations, but monitors them to make sure they don't interfere with commercial stations. And in Japan unlicensed FM stations with up to 10 watts are permitted, with community stations popping up all over the country. Companies such as Teac and Sony are selling micropower FM station kits which include everything needed, even a CD player.

Brazilian Licenses

A note from PU2MPP explains that they have three license classes in Brazil. Class C requires no code. Class B requires 5 wpm code. Class A is 10 wpm. To be more detailed, the Class B test sends 125 characters in five minutes and calls for a minimum of 87 characters to be copied correctly. The Class A is double that. That sure beats our 20 wpm hurdle.

If You're So Smart...

Okay, as a ham you are a communications expert. Well, you're supposed to be. That's what you've conned your non-ham friends into thinking, right?

So what do you really know about communications, other than kerchunking some repeaters or adding still more garble to a pileup? If someone were to ask you about pagers, what could you tell them? How much do they cost? What's their range? Where do you get 'em? What frequencies do they use? What services are available? Can you use some just around your own business?

And what can you tell people about fax-modems? The Internet,

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LETTERS

Number 6 on your Feedback card

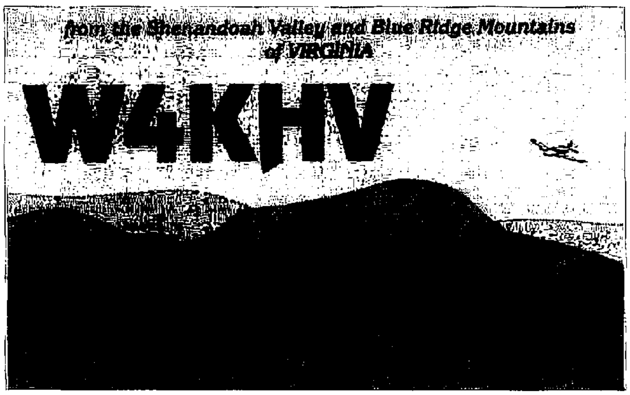
From the Ham Shack

Dick Smith W4KHV Over the years I have enjoyed your columns and find them not only enlightening but thought-provoking. While I have not always agreed with all you have said (does anyone always agree with everything one says?), I do find myself siding with your thoughts most of the time. Superfluous for me to say, keep it up, as I know you will. Thanks. After reading your November editorial I would like to comment on a number of subjects you touched on. First, you asked for letters about most recent building projects, etc. Well, I do build small electronic projects now and then for my other main hobby, RC model planes. I have been in model planes since I was a kid and RC planes since 1949. I have been a licensed ham since 1953 (W1ZVG). However, I do not build much ham equipment now, other than a QRP rig this past year. My antenna will have to be improved before it's a real success. I still build quite a few planes, with my largest being a 9' (wing span) replica of a WWI Sopwith "Pup" biplane. This is an RC plane which is 1/3 scale. I fly on both 6 meters and 72 MHz. Radio "contests" do not move me, nor do nets. About 80% of my hamming is on 40 CW, and I enjoy it. Yes, I know CW is dead to many, antique, etc., and not promoted by people such as youself. But still, it's fun—isn't this what this hobby should be? And yes, the other side of the coin is to develop new ideas, techniques, invent, and pioneer. This where your insight is so valuable to those technically capable. I also participate on a local level in various community projects, including ARES and Skywarn. Your November column was one of your better info columns. In fact, I asked my wife to read it from start to finish (she did). It was the first time she has ever read anything from a "ham" magazine. She was really taken by your observations about the Government cover-ups, roadblocks to cures, health, etc. I'm sure she'll be reading your future colums too. We tried your old recipe for coleslaw. It was very good and we'll be using it again, but with a little less vinegar. Then we'll have a good comparison to make against our favorite recipe. Thanks for giving it out. We both try for low fat foods (and high fiber) so will be giving it try with the low/non- fat ingredients.

Although not a ham as long as you Wayne (I'm 65), I have had a number of honors as result a of being a ham. My highest one was when I lived in the Phoenix area back in late '60s and became one of Barry Goldwater's MARS operators. I ran phone patches from his home to servicemen in the Pacific and Southeast Asia. To this day I don't believe the public, or hams, really know what a contribution he made to the morale of our servicemen in those areas. When I was out there he had two complete stations, one was Collins equipment capable of running 4kW, and one with Drake equipment running 2kW. Aside from spending some long evenings after a day's work, it was fun and most satisfying from a personal standpoint. It's still a great memory.

You can adjust the sourness of the coleslaw dressing by adding more sugar or honey. It's also a fabulous dip for raw veggies. Cheaper than the bottled dressing, too . . . Wayne

Michael D. Zandee AA8QL Gee whiz Wayne, we better keep the code requirement and six license classes, or we won't have anything at all to discuss on the air. Here's my two cents on Mr. Weinhold N3EUL's letter. I'm sure you *can* tell the new no-coders, but not for long. They either conform or the old heads run them off. Then Mr. Goodman W3UWH's call for a senior upgrade: If they want it bad enough they would find a way. It's too bad your friends won't even try. I went from no ticket at all to Extra in four months and found it felt like cheating. It was so easy I didn't get the sense of accomplishment that should have been there.



Richard Heppert KC4YQL In the October issue there was an interesting article by a ham who had finally pushed himself to get his Extra after 46 years. He was now finding it rewarding to work testing sessions and Elmer others through the upgrade process. Bravo! But he was also finding too many of his fellow longtime operators were reluctant to attempt to upgrade because, although they could handle the code speed, they felt they could not learn the necessary math. He proposed creating a special upgrade license for these old-timers as a reward for their many years of "service," and requested feedback on the idea. I had to check to be sure that it wasn't the April issue. This past weekend I participated in a discussion at a local hamfest that worked its way around to the code requirement. It was the opinion of one fellow (my guess is he was 50ish) that he would rather see the FCC drop written tests altogether than see an elimination of the higher speed code requirements—after all, "nobody builds or repairs anything anymore so the tests are irrelevant." The "logic" of the two proposals eludes me—or just maybe I see it too well: Screw any relevant technical knowledge, theory, and regulations, and give higher licenses to those who have nothing better to do than practice the oldest form of communication known to hams—CW. As for the first proposal, the satisfaction of having performed service, had it actually been performed, should have been its own reward. Had these old-timers grown and progressed with the hobby's technology they would have had little trouble passing the technical tests, or at least been less scared to try. As for the proposal to eliminate written tests about regulations, procedure, propagation, antenna theory, safety, band plans, and modes, not to mention basic electronic theory, but keeping CW, this is a blatant cry for elitist "I did it—they should too" mentality. If CW is so important, I'd like to propose re-testing every five years on written and code. If you don't pass you're busted back to Novice and have to work your way back up. Do we see a few quaking in their boots at that thought? Seriously, the FCC tests for each license class should change/grow with the technical advancement of the amateur radio "service," and for a large part they have. The major exception has been the Elements 1B and 1C CW requirements (1A is still necessary to meet ITU regulations). The only way we are going to keep our bands is to recruit, encourage and reward the innovators, not reward hams for merely existing and not causing trouble. Extra privileges and band space should go to the people willing to use and explore newer technologies: after all, from the beginning that is the major reason we were allocated our bands. If any testing changes are made they should start with the elimination of the 1B and 1C elements, with further emphasis placed on today's and tomorrow's technologies, not yesterday's. Grow, or die.

When hundreds of ham clubs, under pressure from the ARRL, wrote to the FCC claiming that the Morse code was of enormous importance for its potential use in emergencies, I said, if you honestly believe what you testified to the FCC, then we obviously should require code tests for every license renewal. Oh, the frenzied screams of anguish that raised.

No, no, they meant that newcomers should learn the code . . . Wayne

Richard A. Medhurst KD6BFO. In response to the letter from Terry Weinhold N3EUL, as published in the October 1995 issue, I must say that the facts do not support his conclusion that the code requirement makes for a "higher-quality operator." A review of the "Happenings" column in *QST* for the calendar year of 1993 would tend to disprove this conclusion. The facts are that during 1993 14 licensed amateurs had monetary action or revocation of license by the FCC. One Tech (7.15%), five General (35.7%), two Advanced (14.3%) and six Extra (42.85%). As you can see, 92.85% have 13-word or better licenses. During a recent public service event in San Diego, a two-by-two call maliciously and willfully interfered with communications. That's a "higher-quality" operator? If the 2 meter band sounds like CB in Mr. Weinhold's area then there is no one to blame other than the pre-no-code amateurs. It was up to them to educate the new licensees as to proper repeater protocol. If they do not know the rules, how can you condemn them? To infer that the only "good" operators are those with code is exactly the type of narrow-minded attitude that keeps the young people out of amateur radio. I do not advocate the elimination of CW, only the easing of the 13-word requirement. I also advocate more stringent technical testing for HF privileges. I may be a lowly Tech, but I have many friends who are General, Advanced and Extra Class who come to me for technical assistance.

Jan Hair N5LVI After reading the letter on Senior Citizens Upgrade, I thought I'd write a response. Maybe who is regarded as a "Senior" is relative to a person's age. I first acquired a General Class license in 1956. Following that year, we added to the family until we had five harmonics. Busyness with family and no antenna shut me down for 17 years after the expiration of

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QRX . . .

Private Ham Satellite

Bob Bruninga WB4APR may become the first ham with his own amateur radio satellite in space. The Glen Burnie, Maryland, ham hopes to have the new amateur radio satellite In orbit by next summer.

No, this is not a joke or a pipe dream. Bruninga is the director of the Satellite Education Laboratory at the Naval Academy in Annapolis and the satellite Is a departmental project. Its primary aim is to provide every school in the country with packet radio satellite access:

"We try to participate in all the SAREX missions with our students. The only problem is probably only 1% of the orbital passes is operational in the packet mode on the SAREX and you never know in advance. It is very hard for the students to go to all this effort and not be able to make a packet link to the spacecraft. So, we think that there ought to be a very low budget, low tech packet satellite up there that is always on, always operational. And every time it comes over any high school in the country the students will see something."—Bruninga

Bruninga says he plans to fly a one-watt Picosat transponder operating on 2 meter FM packet at 1,200 baud. The system is specifically designed for digipeating position reports.

"Once you get the satellite up there then we can track guys driving across the country in their recreational vehicles, we can track guys in their boats out in the bay and up and down the Atlantic...all over the world really. That's why we think there is tremendous potential for position reporting.

"I mean that's what amateur radio is. It's not sitting in your basement. As far as our ability to contribute to the state of the art and to public service, our abilities are not sitting in out basements. Our abilities are mobile."—Bruninga

Bruninga says that he already has a tentative invitation from NASA for a free launch on an experimental booster. The earliest possible launch date is in May. But WB4APR says that the date could easily slip. A lot depends on when the satellite is ready to fly. The parts are within arms reach, says Bruninga, but construction has yet to begin. *TNX Amateur Radio Newsline*

Dove S-band Is On

Still with ham radio satellite news, Jim White WDØE reports that the DOVE DO-17 ham satellite S-band transmitter is on. Jim says that a recent software load allows better power control and controllers now expect to be able to keep the pesky transmitter in operation on 2,401.220 MHz. *TNX Amateur Radio Newsline*

RF Lights

RF light bulbs are on their way and they could add to the QRN currently on the ham bands. This, after the Federal Communications Commission waives its rules to permit the General Electric Company to begin marketing a new RF-powered light bulb.

At GE's request, Part 18 of the commissions regulations has been waived. Part 18 limits on the amount of RF energy that can be conducted into the electric power lines by RF lighting devices in the band 2.2 to 2.8 MHz. GE proposes marketing to consumers an unlimited number of RF light bulbs that comply with the conduction limits for nonconsumer RF lighting devices in this band.

Commission rules already permit RF lighting devices used in commercial environments to place this signal level on the AC power lines. The FCC says that there has been no record of significant interference problems from the use of these devices in commercial environments. It also says that radio operations in the range 2.2 to 2.8 MHz are not normally employed or intended for reception in residential environment. GE was granted a waiver for one year, and the FCC reserved the right to revoke the permit if it determines that RF lighting devices operating under the conditions of the waiver create severe interference problems.

Three years ago, a California company, Intersource Technologies, promoted an RF-powered light bulb that operated at 13.56 MHz. According to the manufacturer it was designed to keep unintentional radiation to a minimum. The company claimed that its 25-watt RF bulb could generate as much visible light as a 100-watt conventional bulb but these lamps were never marketed.

And the ARRL says it has a definite interest in what kind of interference the GE RF bulb may generate. The League says that it will obtain samples of the GE bulbs for testing as soon as they are available. ARRL Laboratory Supervisor Ed Hare KA1CV says that the new bulbs should not, if properly designed, create any more interference to Amateur Radio operations than fluorescent bulbs, dimmer switches, or other similar devices found in the home. Other experts disagree. They point to the problems that a bad incandescent lamp dimmer can create for the average ham. *TNX Amateur Radio Newsline*

Airwave Auction

The Supreme Court has given the Federal Communications Commission approval to go ahead with its planned December 11th auction of 498 licenses for small businesses. A company called Radiofone Inc. had challenged the commission's cellular personal communications services cross-ownership rule, which limits cellular companies to 40 megahertz of spectrum in their cellular service areas.

But in vacating a stay issued by a Federal Appeals Court, Justice Stevens noted that allowing the national auction to go forward would not prevent the federal appeals court from granting Radiofone appropriate relief if it later found that the company's case has merit. As a result, the multimillion dollar auction will proceed. *TNX Amateur Radio Newsline*

1996 VE Test Fee

The cost of getting a ham radio license is going up again in 1996. Effective January 1st, the maximum allowable reimbursement fee for an amateur operator license examination will be $6.07. The FCC set this amount based on the Consumer Price Index between September 1994 and September 1995. It's an increase of 17 cents from the current $5.90 fee.

Actually, nobody really makes any profit from ham radio testing fees. Volunteer examiners and volunteer examiner coordinators are permitted to charge examinees for out-of-pocket expenses incurred in preparing, processing, administering, or coordinating reexaminations for amateur operator licenses. The amount of any such reimbursement fee from any one examinee for any one examination session, regardless of the number of elements administered, must not exceed the maximum allowable fee. *TNX Amateur Radio Newsline*

FCC Wireless Chief Moves

Regina Keeney, chief of the FCC's Wireless Telecommunications Bureau, which oversees Amateur Radio, has been promoted to chief of the Commissions Common Carrier Bureau. Keeney, who has been chief of the WTB since the bureau was formed last December, replaces Kathleen Wallman at Common Carrier.

Regina Keeney is the daughter of John Markey W2AAW and Marge Markey N4XZD. When she was named as chief of the Wireless Telecommunications Bureau she is quoted as saying that she had grown up in an enthusiastic ham radio family.

The FCC, in announcing Keeney's move over to Common Carrier, said that during her tenure at the WTB, she oversaw the commission's auctions of electromagnetic spectrum and worked to develop fair rules of competition in the wireless communications marketplace. Thanks to her leadership, says the FCC, the previous backlog in license application processing has been cut in half.

No successor to Keeney in the Wireless Telecommunications Bureau has yet been announced. *TNX Amateur Radio Newsline*

Paralyzed Assistance Needed

Bill Farley WA5FLG has posted a packet message asking for help for a paralyzed ham. Bill says that Lowell Richardson W5UBW, an avid DX chaser, has become paralyzed but wants to be able to communicate.

Bill says that Lowell no longer can speak. Bill is looking for any device that would help his friend who has the use of one hand only.

If you have any ideas, send them by packet to WA5FLG@K5WPH or call Bill at (505) 437-5508. He is in Alamagordo, New Mexico, and is on Mountain Standard Time. *TNX Amateur Radio Newsline*

Canada Adopts IARP

On the international scene, Canada has announced that it has agreed to adhere to the Region 2 International Amateur Radio Permit. It's the fourth country to do so and has issued the first two permits. These went to Radio Amateurs Canada

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Number 9 on your Feedback card

The SP-10 "Senior Spider" Transceiver

Mike Agsten WA8TXT
405 W. Bogart Rd.
Sandusky OH 44870

You may have heard (or know firsthand) that transmitter power levels of 1 watt or less can indeed "get out" and have accounted for some remarkable feats of DX. It's true.

It's also true that 1 watt, in HF skywave service, has little endurance to spare. You get lucky and snag a good one when the band is optimum and two minutes later, you're talking to yourself because of QSB or QRM at the other end! Clearly, some extra holding power is called for if you want to chew the rag or make 5-WPM Novice QSOs that, of necessity, take longer to complete. The question is, how much will it take to do the job?

When it comes to transmitter power, the sky's the limit of course, up to the legal limit for your license class, but here we also want easy construction and minimal cost to encourage beginners so we'll just split the difference between a measly 1 watt and the widely effective 100 watt levels. And the answer is...10 watts! That's right. To judge the effect of a power change, you must think in terms of dB (decibels) and not be mislead by the watts. Ten watts is 10 dB better than 1 watt and 10 dB worse than one hundred, placing it on middle ground theoretically and in terms of on-the-air readability.

The rig to follow is a simple 10-watt, crystal-controlled CW transceiver that may be built for 80, 40, or 30 Meters. You can build it and learn a little about how it works. Should it ever malfunction, just fix it yourself. There's no need to rely on the service of a distant repair facility. That's independence!

The SP-10

The SP-10 presented here is functionally very similar to its predecessor, the SP-1 (Jan. 1993 issue of *73*) which has enjoyed popularity in the QRP world. The receiver front end is triple-tuned to improve in-band sensitivity and out-of-band rejection. The dual-gate MOSFET receive mixer has been retired and its job turned over to a multifunction IC that also includes an op amp for audio bandpass filtering and a very effective audio muting switch. A low-noise audio preamp stage for increased gain rounds out the receiver improvements.

The transmitter section is pretty much the same as the original "Spider" except here it drives a power MOSFET "afterburner" producing 8 to 12 watts of RF output. Physically, the highly successful SP-1 layout has been retained wherever possible. The additional circuitry requires a larger circuit board which fits comfortably in the next size up enclosure, an RS #270-232 measuring about 8" w by 4" d by 2" h.

> ***"Your brain needs a change of pace and here you get it whenever you close the key!"***

The net effect of these changes is a quantum leap in overall transceiver performance and just a modest increase in cost and complexity. By strictly avoiding "dinosaur" and one-of-a-kind components in the design, easy duplication and maintenance for years to come is almost assured. So get with it and, next time, you'll be the one to say "Rig here is home-brew!"

Circuit Description

The heart of this radiotelegraph transceiver is continuous wave oscillator Q1 (refer to the schematic, Fig. 1). You plug a quartz crystal (more on crystals later) for the desired operating frequency into the top panel socket and Q1 circuitry provides the needed gain and feedback to sustain crystal vibration and supply RF drive to other circuits via the secondary link on T1.

Photo A. Top view of the SP-10.

During receive, incoming signals pass through L5, L4, L3 and series resonant C23/L6 to receiver input circuits T2/C32 and T3/C33 (which are top coupled by C34) and onward to the receive mixer at U3 pin 18. There, in conjunction with oscillator signal via C18 to U3 pin 1, they are converted directly to audio at U3-3, filtered by C59 to remove unwanted RF byproducts and then audio bandpass filtered by the op amp at U3-12 and U3-13, which provides a distinct peak at about 400 Hz. In receive, the audio muting transistor at U3-16 is off (open) allowing signal passage to AF preamp Q6, volume control R47 and AF power amplifier U1 (pin 2 in, pin 5 out). U1 employs a small amount of negative feedback (C52) to roll off unnecessary high-frequency components in the AF output.

Receiver fine-tuning is accomplished by using RIT control R23 to vary the tuning voltage (via R1) to D1. This special tuning diode transforms RIT rotation into variable capacitance which, in conjunction with L1 and Y1, alters the oscillator frequency. Normally, this receiver is properly tuned when there is a 400-Hz difference between signal and oscillator. The resulting beat note provides peak output because it is centered in the audio bandpass response. Frequencies higher and lower receive less amplification. This is how selectivity is

provided; the desired signal is louder unless interference is overpowering.

Automatic receive-transmit switching (QSK) is initiated by closing the key. Q8 switches on, rapidly energizing the 12T bus which, in turn, accomplishes the changeover to transmit by switching several circuits. 12T via D8 mutes receive audio by placing a short circuit at U3-16. It turns on sidetone generator Q7 (a unijunction transistor or UJT) via R38 and R39. Sidetone allows you to monitor your telegraph sending quality by providing a nice, tight feedback loop that includes ear, brain, fist, and key. The sidetone in this rig also provides an important secondary function. Its complex, harmonic-rich output soothes your brain by dispersing all those headache-forming neural knots that may come from excessive sine wave exposure during receive. Your brain needs a change of pace and here you get it whenever you close the key!

Moving onward, 12T via R25 and Q5 grounds D1 tuning voltage to provide transmit offset which allows same-frequency transmit-receive with other stations. It switches Q3 on, enhancing oscillator output level via R5 and assisting transmit offset with C3. Finally, 12T keys Q4, which permits Q2 to amplify the incoming oscillator signal. Q2 output via low-pass filter L2 and resistive pad R14-17 then drives final RF power amplifier Q9 to full output of 8 to 12 watts, depending on band, power supply and transistor grade.

Harmonics present in this raw power are attenuated to insignificance by low-pass filter L3-L4-L5 and associated capacitors. Since the receiver input is tied directly to transmitter output at C23, D4-D7 are included to protect the receiver. Transmit RF turns them on and, while in conduction, they place a near-short at the junction of C23 and L6, breaking up the series resonance and forcing C23 and C22, because of their relatively low capacitance, to look like a high impedance during transmit, thus blocking most of the RF. This technique was actually developed for radar equipment where a sensitive receiver and high-power transmitter had to share a common waveguide. What you see here is the same principle in a less pure but still adequate form.

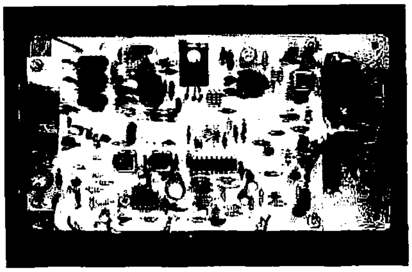


Photo B. Bottom view of the SP-10.

Construction

In the top view photograph of the SP-10, you can see the octal-type crystal socket in the left-rear corner. Since this socket holds two FT-243 or similar crystals, DPDT switch S2 is provided just in front to select one or the other. TB1, a four-lug terminal board, mounts along the rear edge of the top panel, near the right-rear corner. Its terminals are numbered 1 to 4 going from left to right. Connections to TB1 are DC power to 1 (+) and 2 (-) and antenna system to 3 (coax shield) and 4 (center). Along the right edge are 3.5-mm jacks for speaker/headphones (J2-rear) and external telegraph key (J1-front).

The built-in telegraph key is just left of the jacks. Its arm, a 3" strip of .025" thick brass or aluminum, is mounted on 1/4" spacers and grounded to the top panel by its two mounting screws. The key knob, a rubber or plastic equipment foot, is fitted or glued to the hex nut attached with machine screw, up through the arm. The head of this screw is the upper contact. The key contact beneath the arm is a 6-32 brass machine screw with head filed flat. This screw is insulated from the top panel with a shoulder washer above and fiber washer below, and secured with flat washer, solder lug (for connecting to) and hex nut.

The two knobs front and center on the top panel are Volume control R47 on the right and receiver incremental tuning (RIT) R23 on the left. Just left of RIT is slide switch S3, unused here but available for extra audio filtering (to improve selectivity) or other contingencies. Left of S3, in the left-front corner is DC-power control switch S1.

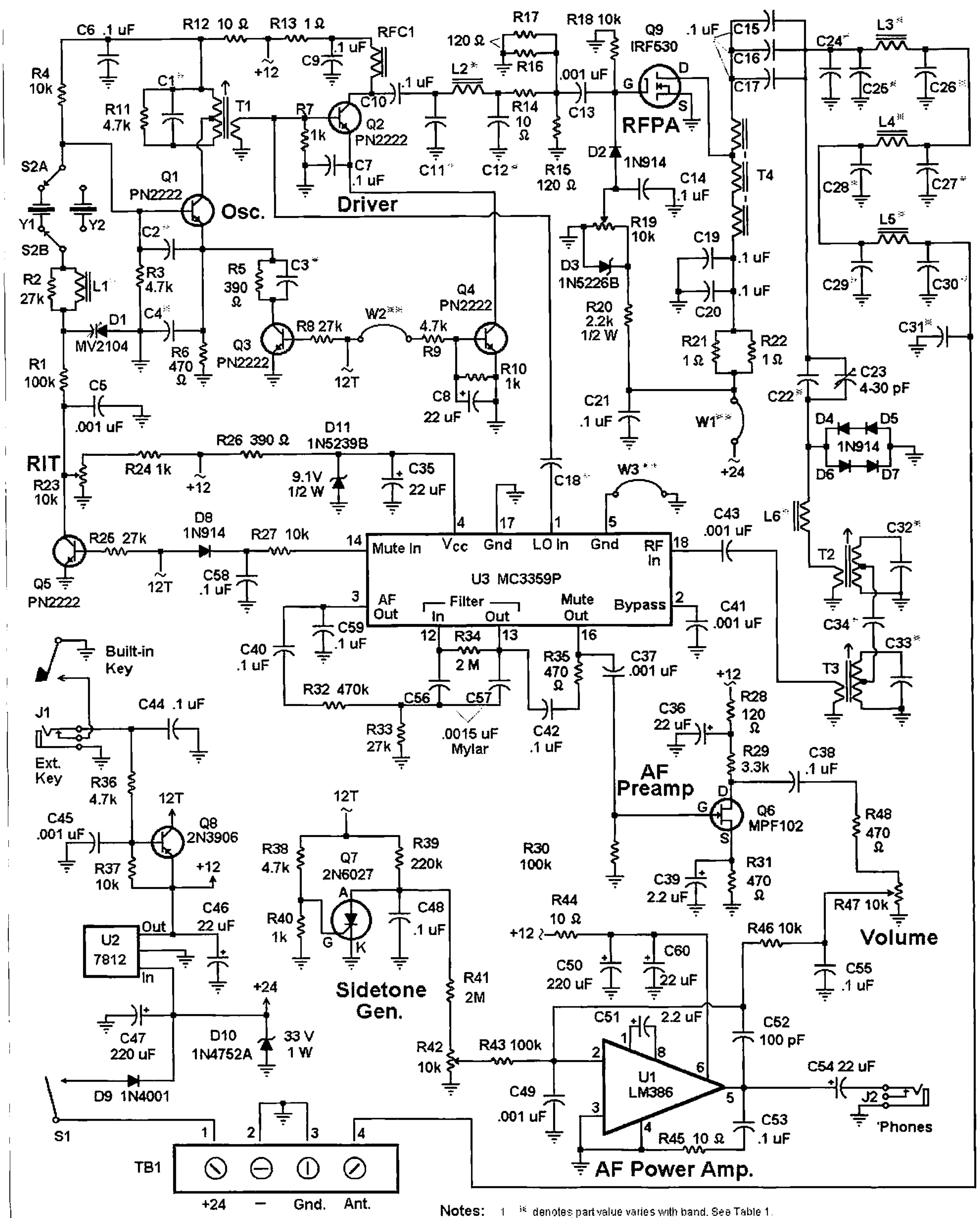
Running front to rear between RIT and Volume, and below the top panel, is a 1" wide by 3" long by 3/8" thick solid aluminum slab that provides heat sink and mounting platform for RF power amp Q9. This slab, to further increase heat dissipation, is attached directly to the aluminum top panel with three machine screws, heads visible in the photograph.

Most of the project is contained on the PC board depicted by the etching pattern in Fig. 2 and the parts overlay, Fig. 3. Of special note on PC board assembly, voltage regulator IC U2 needs 2 to 3 square inches of heat radiator coupled to its mounting flange. I cut and bent a piece of .025" aluminum sheet as shown in photo B (inside view) and on the parts overlay, and installed it between U2 and the PC board.

T4, the trifilar-wound matching transformer, uses two of the specified core placed side-by-side. The wire winding holds them together, no problem. Don't be intimidated by "trifilar winding." All you do is cut three equal length wires and twist them into a bundle. Thread the bundle onto the core until you have the specified turns count. It should look like an octopus with six tentacles coming off the bottom. Trim excess wire but allow enough for connections and installation. Now you have three wires on the core, arbitrarily designated A, B and C, and color-coded or tagged for easy identification. Connect the end of A to the beginning of B. Connect the end of B to the beginning of C. The beginning of A and the end of C remain single and go to "Com" and "Out" at T4 on the PC board. The two cross-connections go to "X" and "in." Voilà!

Because Q9 is the last part installed, even after the PC board is mounted to the top panel, provision must be made for connecting it to the top side of the board. I used short "flea clips" as mounting posts at holes G, D, and S. Anything snug enough to remain tight when reheated will do the trick here. In other words, you don't want the mounting posts to come loose from the PC board when you're attempting to solder the leads of Q9!

With the PC board complete, use it as a template to mark its corner mounting holes on the inside of the top panel as shown in Photo B. The heat sink slab mentioned earlier runs from beneath the rectangular Q9 cutout to the area between Volume and RIT. Drill and tap a 6-32 mounting hole for Q9's flange in the heatsink, positioned so Q9 leads will bend and reach the PCB mounting posts.



Notes:
1 * denotes part value varies with band. See Table 1.
2 ** W1-3 represent bare wire jumpers needed with the accompanying pcb layout.
3 Both C9 and U2 require a heatsink. See text and photographs for details.
4 Component ratings: Unless specified, resistors are 1/4 W, electrolytic capacitors are 35 V and ceramic disk capacitors are 100 V.

Figure 1. Full schematic diagram of the SP-10 "Senior Spider."

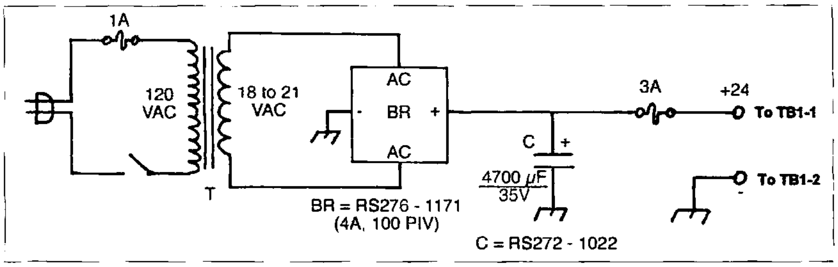


Fig. 4. SP-10 power supply.

Follow the photos to lay out and install the remaining top panel parts, the positioning of which is much less critical than the need to keep Q9 cool.

Except for the short ANT/GND and Y1 wires, connect the PC board to top panel components as shown on the schematic diagram or parts overlay. Hinge the board over and mount it to the top panel on 5/8" metal spacers, and then connect the short wires to TB1 and S2. Check to ensure the copper side of the PC board is not touching any panel components like potentiometers or jacks. Lastly, install Q9 to the heat sink using a heat conductive insulator pad and 6-32 Teflon or nylon screw or a TO-220 transistor mounting kit, to couple the flange thermally but not electrically to the heat sink slab.

Power Supply

A suitable power supply for the SP-10, one supplying 18 to 28 VDC at 1 amp, can be as simple as a DC wall adapter or a pair of 12V batteries wired in series. There's no need for a fancy, electronically regulated unit. Precise regulation, where needed, is already supplied by U2. The external supply should, however, be beefy enough to hold its output voltage within 20%, going from key-up to key-down. For example, a source measuring 25 VDC should drop no lower than about 20 volts when you close the key. The no-load input can be as high as 32 VDC; beyond that point, protection zener D10 may conduct and if it does, it will probably short circuit in the process of protecting the SP-10 from overvoltage.

If you wish to build a power supply from scratch, the classic transformer-rectifier-filter arrangement shown in Fig. 4 will work just fine. Regardless of the power supply you choose, be sure to provide an inline fuse in the plus lead running to TB1-1. Start off with a 1-amp fuse if possible and, if all goes well, upgrade it to 2 or 3 amps for normal operation. This conservative approach to firing up new, untested equipment will minimize casualties should anything be amiss.

Crystals

The operating frequency of the SP-10 is controlled by a single crystal in transmit and receive. With crystals, you give up the ability to wander (or drift!) around the band in exchange for excellent frequency stability, intrinsic dial readout (frequency is marked on the crystal) and simplified project tune-up, requiring very little test equipment. For the beginner, or the old-timer into "radio karma," crystal control is a good way to go.

The actual crystal is a thin square of quartz too fragile and sensitive for direct handling. Rather, it is mounted in a holder which, depending on type, plugs into a crystal socket or is wired directly into the equipment. The octal crystal socket on the SP-10 accepts two of the popular FT-243 holders, having a pin spacing of .486" and a pin diameter of .093." Types HC-17 and Petersen Z-9 are also compatible. In general, any fundamental crystal with a frequency in the chosen band will work if you can adapt it to plug in. For example, even the miniature HC-18 holder with leads instead of pins may be wired to the base salvaged from an unneeded octal vacuum tube, which will then plug in.

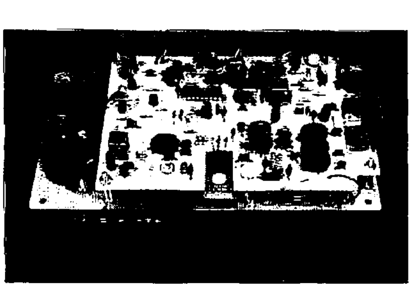


Photo C. The SP-10 at an angle.

Getting crystals is like ordering pizza. Unless you are buying a stock or popular frequency, they are tailor-made by a manufacturer upon receipt of an order. That's why delivery can sometimes take 2-3 weeks or more; you must allow for lead time! Some manufacturers require the Y1 specifications provided in the Parts List while others will do the job if you merely order "amateur-grade crystal" and specify the frequency.

If you're a Novice, don't crowd the edges of your subband when ordering crystals, unless you have the means to ensure the crystal you're using is "in-band." The reason is, a general purpose or amateur-grade crystal ordered for, say, 7102 kHz, may actually put out on 7100. It's a matter of manufacturing tolerance and circuit correlation. If in doubt, give band edges a wide berth.

Tune-Up

The key to a smooth, uneventful tune-up is to do a careful job during construction. Having done your best, let's see if it works! On the PCB, set R19 Bias and R42 Sidetone each to midrange. Connect the power supply to TB1-1 (+) and TB1-2 (-) and a 50-ohm dummy load with relative power meter or wattmeter in line to TB1-3 (coax shield) and TB1-4 (center conductor). Lacking this test equipment, build the simple terminating RF indicator shown in Fig. 5 and connect it to TB1-3 and TB1-4. This gizmo provides a suitable resistive load for low power transmitter testing, as well as a visual (and thermal—it gets warm to hot!) indicator of RF output.

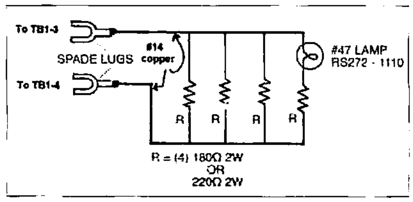


Fig. 5. Terminating RF detector.

Plug a speaker into J2. Insert a crystal into the socket and select it with S2. Switch on power with S1, close the telegraph key and adjust T1 for maximum RF output indication. Adjust R42 on the PCB for desired sidetone level. Replace the dummy load with an antenna or signal generator at the crystal frequency and adjust C23, T2, and T3 for best reception.

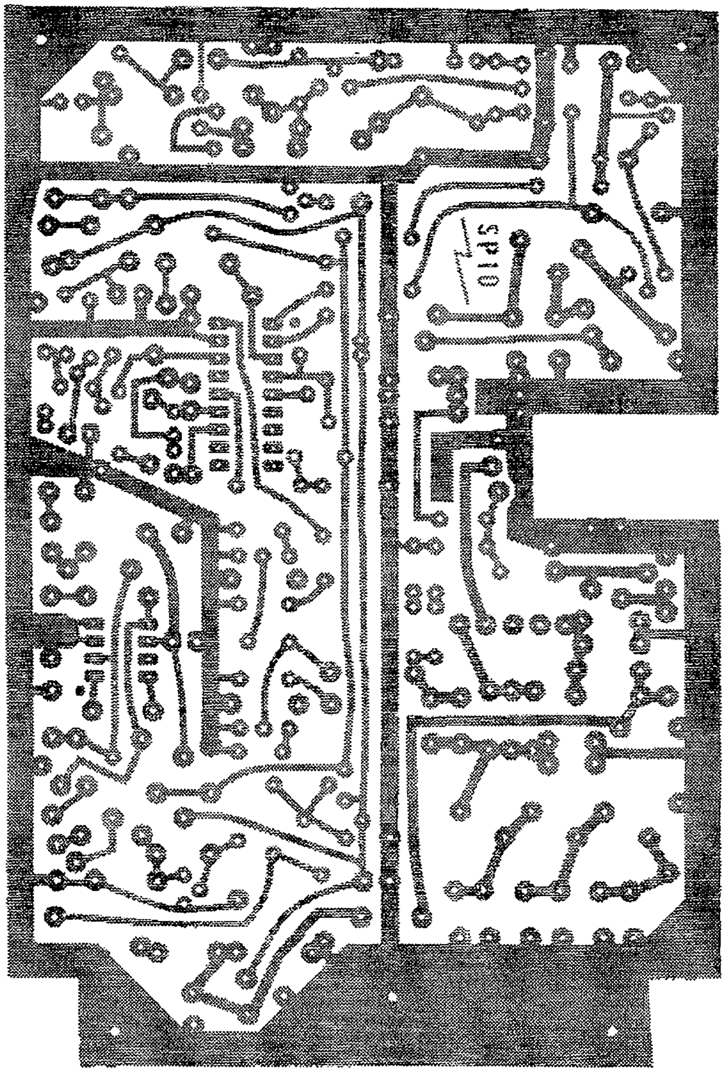


Fig. 2. PC Board foil pattern.

Some patience is called for with the antenna method; you may need to wait for a signal strong enough to be heard through the as yet unpeaked front end. A temporary clip-lead jumper from the anode of D6 to the upper lead of C34 may help by allowing you to get T2 and T3 in the ballpark first. Then remove the jumper to peak C23 and touch up T2 and T3.

On the Air with the SP-10

Like all modern transceivers, the SP-10 prefers to see a 50-ohm antenna system with low SWR. The classic half-wave dipole comes close to ideal without the use of extra matching techniques. Other antennas like the G5RV or random wire will require an antenna tuner to provide an acceptable load. If operation into a less than perfect match is unavoidable, it might be wise to reduce the operating voltage from, say, 24 VDC to 18 VDC. This will reduce the adverse effect (Q9 overheating) of a somewhat high SWR.

With its rather broad selectivity, it can be questionable whether or not signals heard on the SP-10 are close enough to your crystal frequency for a QSO. Those that decrease in pitch and approach zero-beat with RIT control moved fully counterclockwise are very close. Others may be workable if the operator tunes around for your signal.

Though 10 watts is considered low power, it's right up there with the popular one-tube 6L6 transmitter (and countless variations) that propelled tens of thousands of hams into the ether in their early radio careers. The receive section is certainly no worse (and probably better) than those "drifty," broad-tuning superhet Novice receivers we once cherished and still remember fondly. They did the job! And on most any night the SP-10 can be your doorway into a wonderful world of Morse and static, faceless names, exotic places, and colorful QSL cards—all the more exciting when you build the rig yourself!

SP-10 Condensed Parts List

C1-C4, C11-C12, C18, C22, C25-C34	(see table 1)
C23	4-20 pF trimmer, Mouser 24AA022
C56, C57	0.0015-µF Mylar™
D1	MV2104, ECG612
D2, D4-D8	1N914, RS 276-1122
D3	3.3V .5W zener diode (1N5226B)
D9	1N4001, RS 276-1101
D10	33V 1W zener diode (1N4752A)
D11	9.1V .5W zener diode (1N5239B)
J1-J2	3.5 mm closed circuit mini phone jack
L1-L6	(see table 1)
Q1, Q3-Q5	PN2222, ECG123AP, RS 276-2009
Q2	2N2219A, ECG128, RS 276-2030
Q6	MPF102, ECG312, RS 276-2062
Q7	2N6027, ECG6402
Q8	2N3906, PN2907A, ECG159
Q9	IRF530
R19, R42	10k PC trim potentiometer, RS 271-282
R23, R47	10k audio taper potentiometer, RS 271-1721
RFC1	22-µH epoxy coated, Mouser 43LS275
T1-T3	Mouser 42IF123
T4	8 turns #24 enamel wire, trifilar wound on two FT50-43 (Amidon) cores
TB1	4-lug terminal board, Mouser 534-4190
U1	LM386 audio amp, RS 276-1731
U2	7812 voltage regulator, RS276-1771
U3	MC3359P (Circuit Specialists)
Y1	Fundamental crystal, specify desired frequency, parallel / 32-pF load, .005% tolerance, holder type FT-243, HC-17/U or equivalent.

Note: Check the advertising in this magazine for parts suppliers. For a free list of parts sources for this project, send the author an SASE requesting SP-10LST. PC boards and project kit for the SP-10 "Senior Spider" are available from Lectrokit, 401 W. Bogart Rd., Sandusky, OH 44870 (no telephone).

Continued on page 17

Low Cost Switching Power Supply For HF Transceivers

by Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

I have been using a Ten-Tec 938 switching power supply for some time with my Kenwood TS-50S for portable operation. This switching power supply is very small, efficient, and lightweight (2.5 pounds) and lets me operate my TS-50S at 50 watts output continuously. However, for base station use I wanted the full 100-watt output power capability of the TS-50S. A full 20-amp linear power supply weighs three to four times what the TS-50S does, and is two-to-three times larger than the TS-50S. It just didn't seem right to have a power supply that overwhelmed the TS-50S in size and weight. What I wanted was a small, lightweight switcher with 20-amp capability. Unfortunately, no one seems to make these at this time for amateur use, and commercial switchers are very expensive. Oh, what to do!

I, like many of you, receive lots of catalogs of surplus electronic stuff through the mail. Many of these catalogs list all kinds of DC power supplies, both new and used. My favorite surplus catalogs are from Marlin P. Jones & Associates (407-848-8236), All Electronics Corp. (818-904-0524), and Hosfelt Electronics (800-524-6464). I recently noticed that Marlin P. Jones & Associates was advertising a 12-VDC 20-amp switching power supply for only $49. This was a used Lambda power supply that is 9" x 4-7/8" x 2-7/8" and had a shipping weight of only six pounds. This seemed great, but could it be made to operate at 13.8-VDC output? There was only one way to find out—so I ordered one.

"This surplus treasure turned into a 20-amp switching power supply that is smaller than a TS-50S, weighs less than six pounds, and costs less than $60 total!"

A few days later the power supply arrived. It is a used Lambda LYS-W-12 power supply rated at 20 amps continuous at 40 degrees C, 18 amps at 50 degrees C, and 15 amps at 60 degrees C. The input to the supply can be 105–132 VAC at 47–63 Hz, or 130–160 VDC. This power supply has no switches, fuses, connectors, or indicators. When I removed the cover, I found that the DC output connectors were #10 studs on the PC board, and the AC inputs were just pins on the PC board to solder a line cord to. Everything was well marked on the printed circuit board, along with an output voltage adjust potentiometer. So, first things first—could I operate the supply at 20 amps at 13.8 volts? I had a 20-amp load made up of twelve 8-ohm power resistors. I connected a voltmeter and oscilloscope across the load which was attached to the DC studs, soldered an AC line cord to the AC input pins and plugged it in. The output came right up to 12 volts! I next adjusted the voltage adjust pot and easily got 13.8 volts! Finally, I measured 150-mV p-p output voltage and 10-mV p-p ripple on the DC output at full load with my oscilloscope.

Now I needed to make the power supply user friendly—I needed to add a switch, fuse, indicator, line cord, and DC output cord to the unit. This was pretty easy to do as the basic frame that the power supply is mounted in has a number of small unused holes in it. Apparently this chassis base is used on a number of different power supplies. Fig. 1 shows a side view of the power supply with the cover removed and the components I added. On the 4-7/8" x 2-7/8" blank side of the supply, I drilled out the two unused holes on the left side (See Photo A) for a SPST 10-amp switch (Radio Shack RS 275-324), and an LED. On the back, silk-screened side (See Photo B), I drilled out one hole large enough to pass a pair of #12 wires for the DC output, and one hole large enough to take a #8 screw for a ground stud. The photographs illustrate this very well. There is already a "half-moon" cut out in the back that easily passes an AC line cord. On the inside of the power supply, I wired an in-line fuse holder (with a 5-amp fuse) in series with one side of the AC line cord, and wired the line cord to the switch and AC input pins on the printed circuit board. I wired the LED with a 750-ohm series resistor to the solder lugs on the 12-volt studs. Next, I attached #10 solder lugs to the #12 wire that passes out of the supply and then attached the

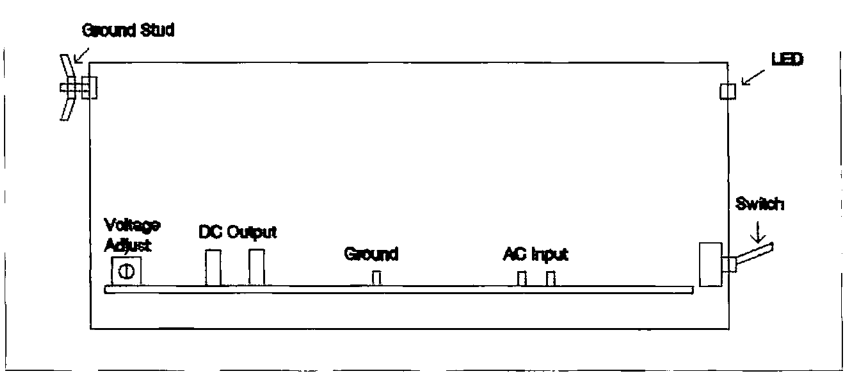


Fig. 1. Switching power supply side view.

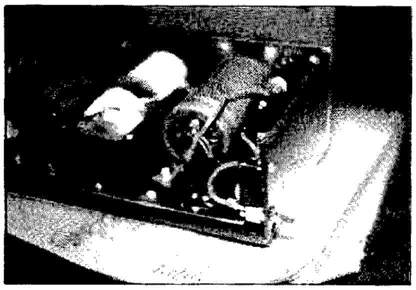


Photo A. Blank side.

solder lugs to the DC output #10 studs. The DC output is floating with respect to ground, so attach a wire from the negative DC terminal to the ground pin on the printed circuit board. Finally, I terminated the #12 wires on the outside of the power supply with a 20-amp Radio Shack "Molex-type" female connector (RS 274-154). The ground stud for tying into your station ground is a #8 screw with the screw head mounted inside the power supply. Use lock washers inside and out, and a #8 nut on the outside to hold it in place. I used a #8 wing nut and two #8 washers to make an easy-connect ground stud.

That's it. This surplus treasure turned into a 20-amp switching power supply that is smaller than a TS-50S, weighs less than six pounds, and costs less than $60 total! And, it is perfect for both base station and portable use. Since this is a surplus power supply, it will probably show up from time to time in different surplus catalogs. So, keep your eyes out for this or similar power supplies. These commercially rated switching power supplies are real treasures and are adjustable for amateur 13.8-volt DC power requirements. 73

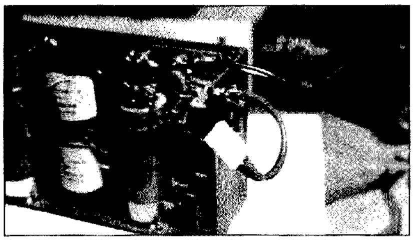


Photo B. Back, silk-screened side.

The SP-10 "Senior Spider *Continued from page 15*

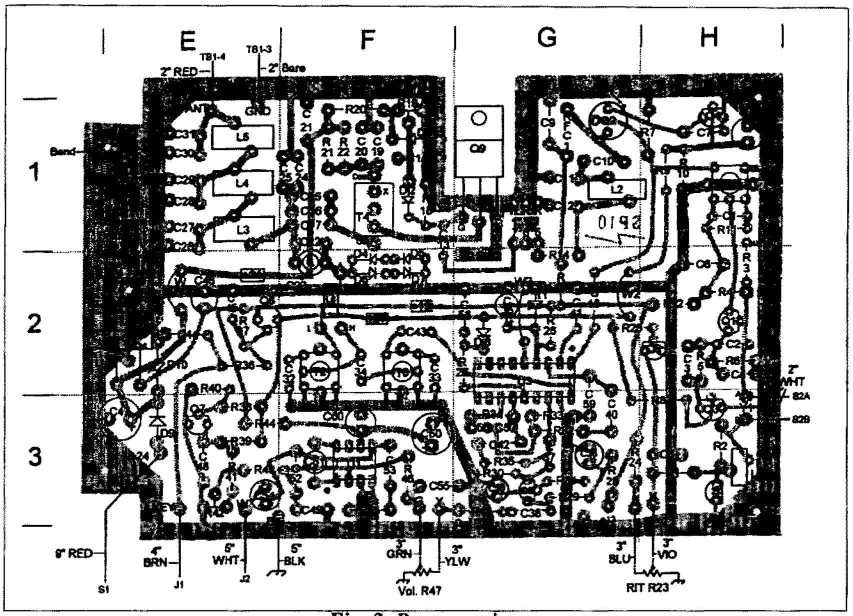


Fig. 3. Parts overlay.

Table 1 Band Data

Component	80-M	40-M	30-M
C1	390 pF	68 pF	Not used
C2	18 pF	5 pF	Not used
C3	680 pF	270 pF	Not used
C4	820 pF	680 pF	390 pF
C11, C12	820 pF	390 pF	270 pF
C18, C34	39 pF	18 pF	10 pF
C22	18 pF	Not used	Not used
C25, C31	390 pF	270 pF	180 pF
C26, C28	390 pF	Not used	390 pF
C27, C29	820 pF	680 pF	68 pF
C30	68 pF	Not used	Not used
C32, C33	390 pF	68 pF	Not used
L1 (FT37-61)	40T #30	23T #28	17T #28
L2 (T50-2)	22T #24	14T #24	12T #24
L3, L5 (T50-2)	22T #24	17T #24	14T #24
L4 (T50-2)	25T #24	19T #24	16T #24
L6 (FT-37-61)	30T #28	25T #28	15T #28

Capacitors are 100v ceramic disk type. For inductors, wind turns using the enamel wire gauge given on the toroid core specified.

SP-10BBM, $16 ppd. US/CAN, includes bare PC board and step-by-step construction manual. PC board and parts (including band parts for 80, 40, 30 meters), and case parts including drilled and tapped heat sink. The RS 270-232 case and crystal(s) are not included but a mailer for sending in your top panel for free master template marking (with metal work option extra) is included. This pricing is valid within four months of publication. Order direct or send an SASE for current details. 73

Simple Mobile Protection

Safely ward off those evil spikes.

L. VanProoyen K8KWD
8330 Myers Lake NE
Rockford MI 49341

I consider a "good" mobile radio installation one that is unobtrusive. With the variety of radios with detachable control panels, it's fairly easy to go mobile without having your car's interior resembling something like the space shuttle's cockpit.

As a further aid in achieving an unobtrusive installation, many vehicles include one or more blank DIN panels on the dashboard, sized perfectly for installation of many of the detachable control panels. I know of one instance where a ham was able to install an entire Kenwood TS-741 in place of such a panel, and when he completed the installation it looked like a factory original option.

I have one problem with unobtrusive installations, though:Unobtrusive means not noticeable, which means I can forget to shut my radio off when leaving my car. Even those "wheat grain" bulbs can kill a battery, given enough time.

The Ignition Key Control Solution

Because of my forgetful nature, I like it when everything turns off when I remove the ignition key. Achieving total key shutoff can be complicated since most manufacturers recommend connecting the radio's power cable directly to the battery. This is particularly important with 100-watt class radios, which use a lot of current. Also, many manufacturers recommend shutting your rig off when starting the car's engine. That's because radios can be intolerant of irregularities in their power source. The starting process can produce deep sags in the vehicle's supply voltage and high amplitude spikes, which could zap your radio.

To meet my first need (direct battery connection), I used a relay mounted in my engine compartment near the battery (Photo A). Use of a relay is a legitimate method of connecting power to a radio. The relay I used is one commonly used in mobile two-way radio installations. I got it, together with a fuse block, from a local two-way shop. It can handle 30 amps continuously and has an 80-ohm coil.

I've seen similar relays for sale at auto accessory shops as horn-relay replacements. The relay's contacts should be rated for at least 50% more current than the specified maximum current of your radio, and the relay should be a sealed type (no sparks).

The power control relay must be well secured to the vehicle. The relay and fuse block should be screw-anchored to the inside wheel-well cowling or some other suitable surface near the vehicle's battery. Locating a place can be a challenge in some feature-packed cars. A vehicle's engine compartment is no place for loose items. Also, check out what you might be drilling into before drilling.

Many vehicles use batteries with side connection lugs. I've seen some "interesting" wiring techniques done

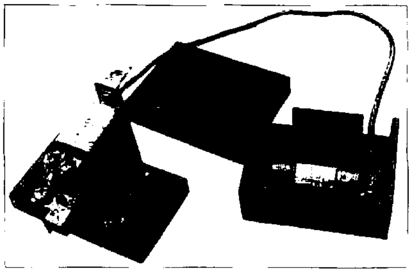


Photo A. Typical control relay and fuse block suitable for use with 100-watt mobile radios.

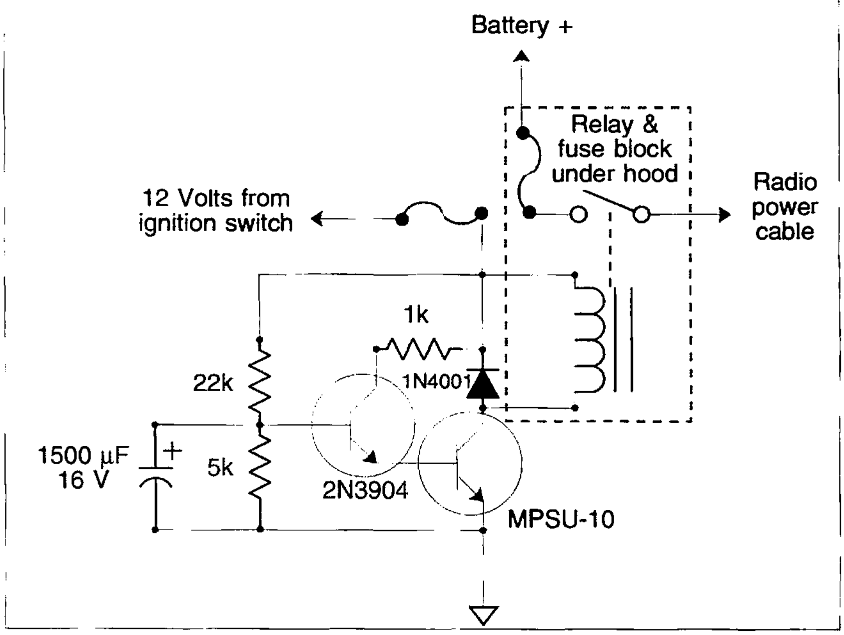


Fig. 1. The on-delay timer circuit.

when trying to connect a radio cable to this type of battery. Most auto accessory stores carry an adapter block for connecting auxiliary wires to such batteries; I recommend using one.

An On-Delay Circuit

A simple method of controlling the power relay circuit would be to tap into the car's accessory circuit, such as at the car radio's fuse. Most vehicles are wired so that the radio's power turns off when you're starting. While this works OK, I didn't like power coming on, dropping out, then coming back on again, so I decided to use a delay circuit that would keep the power relay from energizing for a few seconds after key-on.

After failing to make something simple using a 555 timer IC, I settled on the circuit shown in Fig. 1. I used two transistors I had available because I needed a combination of a relatively high RC time constant circuit that limited the base current, together with high current switching. You could probably substitute a single, high-gain Darlington-type device and get the same results.

Using the values shown, the circuit provides about 10 seconds delay before the relay pulls in. I built the circuit on a small piece of perf board, as shown in Photo B. The circuit layout is not critical, although it should be built to fit some type of enclosure that can be secured to the vehicle somewhere out of the way, like up under the dash.

I used a 1,500-µF capacitor as the basic time-delay element. It charges through a 22k-ohm resistor until the 2N3904 is forward biased and conducts, thereby switching the MPSU-10 on. If you want to change the time delay, substitute other capacitor values. Don't

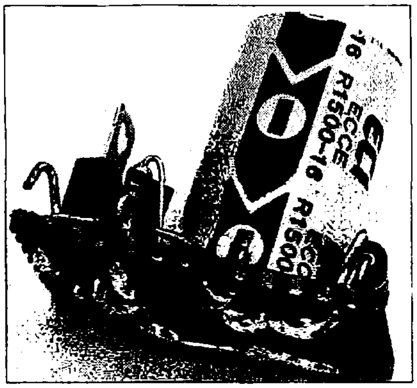


Photo B. The on-delay timer construction details.

tinker too much with the resistor values as they were selected to produce the proper base-emitter current flow. Note that I used a 1k-ohm resistor in series with the 2N3904's collector. This resistor limits the MPSU-10's base-emitter current, and it also serves to keep the 2N3094's collector current within proper limits.

I mounted my entire assembly inside a small snap-tight plastic box and drilled holes for the wires. The only connections necessary are the source of key-switched +12 volts, ground, and the relay coil return.

Connecting to the Vehicle's Key Circuit

A convenient method I've used to pick up key-switched +12 volts is by using a modified "blade" type fuse (Photo C) and inserting it into an unused slot in the vehicle's fuse block. Most newer vehicles use this type of fuse, and I can usually find an unused spot in the fuse block that is key-switched.

"The judicious use of fuses is very important when doing automobile wiring (note the in-line fuse I use with my modified blade fuse)."

In the event there is no available slot for the fuse, you can substitute a modified fuse for an existing fuse, e.g. the radio fuse, but if you do I would recommend modifying a fuse that is rated correctly, not the 20-amp one I used. The judicious use of fuses is very important when doing automobile wiring (note the in-line fuse I use with my modified blade fuse). I used a 1-amp fuse in the line to my delay timer circuit and power control relay.

One note of caution if you decide to replace the broadcast radio's fuse: My newest car has a factory radio that's equipped with a password-protected theft-deterrent feature. If this radio is disconnected from battery power without defeating this protection scheme, the radio will become totally useless when reconnected. I'm told not even Delco can help if you turn this feature off. It would be wise to check with your dealer to find out if you may have such a radio prior to disconnecting it!

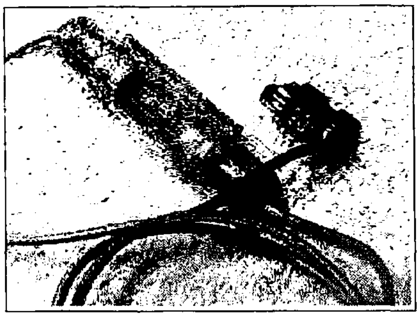


Photo C. Modified "blade-type" fuse useful in connecting to a car's key-switch circuit.

While on the subject of fuses, if there's a rule to consider above all others, it's fuse everything! Don't underestimate the dangerous potentials of an automobile's electrical system because of its low voltage. A car's battery is a powerful energy store that can produce explosions, fire, and bodily harm, if not treated with respect.

Special consideration should always be given to vehicle wiring. From a general safety standpoint there should never be any loose wires. Wiring in an engine compartment should be routed to be clear of any potential hot spots, e.g. exhaust manifolds, etc. Locations near fans, pulleys, and belts, should also be avoided. After locating a safe path for running wires in the engine compartment, the wires should be tied down using cable ties.

The radio's controls should be located such that you do not have to take your eyes off the road to operate the radio.

Safe mobiling, everybody! 73

Number 22 on your Feedback card

Going Public

Put a different kind of ham on the screen!

Jeff Brone WB2JNA
108 Shiley St. Apt. B
Annapolis MD 21401

We need to make the public more aware of what we do. As ham operators, we could benefit much by enhancing the public's knowledge of our hobby. The rewards would be great. We could gain operators and have more influence in the world. The prestige we acquired would give us power, expand our possibilities, and maybe even help us get better tables at restaurants. In the past I have mentioned to headwaiters that I was a ham, but it did me little good, although I knew that they were impressed because they did that thing that people do when they're trying to hide their being impressed. Their eyes glazed over and they looked bored. I wasn't fooled by that, but I was still disappointed with my table. Think about this: We hams have a very exciting hobby. We handle emergency messages in disasters; we communicate with people all over the world; we further good international relations; and we use solder! What we do is fascinating, yet relatively little is known about us by non-hams. Why? In a word: popular culture.

Americans love their TV and movies, and we hams just haven't been exposed enough in those avenues. I believe that in the TV program "Alf," Willie, the father, is a ham, and in "The Simpsons," one of Marge's sisters is a ham, as is Bart's schoolmate who calls himself, appropriately, "Ham" (the boy is kind of a nerd, which really doesn't help us). Radio communications plays a part of most every deep sea submarine movie, but that's only tangential publicity for us. I do remember that in the Mel Gibson film "The Man Without a Face," about a deformed, lonely ex-schoolteacher. I was sure that I saw some QSL cards on the wall of his character's house. Still, these are small victories. If we are to break into the public's mind, it's going to have to be by our own hand, or, as I shall explain, pen.

The solution is simple: Write the vehicle ourselves. We need to write the screen play or TV show that will give us the notoriety we so deserve. With that in mind, I have come up with some ideas for just that exact movie or TV program that will do the job. And yes, I will remember all the little people that I met on the way to the top.

First, I propose a TV situation comedy. America loves them, and the right ones capture the imagination of the whole country. Mine is a delightful, family-oriented comedy about Marconi- I call it "Darn that Guglielmo!" In it, Marconi is an average-guy brilliant inventor just trying to make ends meet and keep his family happy. I envision one episode where his wife is out of town and he has to make dinner for his two children and his tough old boss, Mr. Prendergast. The usual comic machinations ensue: Marconi lets the rice boil over, he puts too much soap in the laundry, and he discovers wireless radio and forever changes the face of communications. Also, I think something really funny could happen with some spaghetti, though I haven't worked out the details on that one.

I'd like to see Tony Danza in the title role–he's funny, he's likable, and he's Italian. I think this show would be very popular with brilliant European inventors living in New England and the Canadian Maritime Provinces. I've heard that is a very important market group.

My next idea is exciting because, at last, we have a "ham radio hero" in a feature film. It concerns a combination ham and martial arts expert who specializes in CW operating. I call it "Morse Code of Vengeance." As a young child, he was very shy and had difficulty talking with others. He finds himself through two pursuits: CW ham operating, because it allows him to overcome his fear of speaking up; and martial arts, because it allows him to break things. As he matures, he blends the rhythms of self defense movements with the rhythm of CW. Later, he is called on by his government to break up an international ring of electronic equipment thieves. This film has everything: action, adventure, romance, and electronic keyers. In the final scene the hero, and a small group of elite commandos, dressed in green military fatigues and callsign baseball caps, infiltrate the criminal's lair while they communicate on HTs. As the hero confronts the head thief in a final showdown, the hero dramatically challenges his foe with "C'mon baby, let's QSO."

I'd like to add that there's no reason why the hero in this film can't be a woman, with very few plot changes necessary. Use of a female hero may make the film even more popular, although its name should be changed. Some suggestions are "Velvet Fist of Revenge" or "YL: This Time It's Personal."

Made-for-TV movies have a large following, and we could certainly tap into this market. My idea is a steamy romance called "CQ for Desire." It has deep emotional conflicts, searing passions, and radio equipment. Eddie Ribalski, a rough-edged longshoreman ham in Galveston, TX, uses the legal limit of output power and wouldn't think of operating without his linear amplifier turned on. He loves his loyal wife, Linda, and everything is fine until he meets Heather Arnold, a career woman who has risen to the top of the breakfast cereal buying industry and operates only low power. Initially, Eddie hates her, but they gradually become friends until that climactic night when he takes her into his shack and lets her operate his rig. She is intoxicated by the power and can't get enough of it. He is thrilled by his influence over her and lets her operate whenever they can meet. They know it's wrong, but they can't stop. Finally, Eddie's wife finds out and confronts him about the relationship. He vows to break it off, and Eddie and Heather meet later on a windy hilltop, right next to Eddie's antenna tower. They say good-bye, and Heather tells him, "It was too much, far too much for either of us to control, but a little bit of you will be in my feedline forever."

I know what you all must be thinking: "How can I come up with brilliant concepts like these?" I must admit, I have a lot of ideas, so many that it's kind of scary. Actually, my friends call it "disturbing," but you see my point. However, you can have lots of fun getting ham radio into the mainstream in other ways. Get involved in a special events demonstration station, teach a class in radio, show a friend or neighbor your rig, or just let your natural enthusiasm show as you describe your hobby to your friends or co-workers. If you find yourself getting really carried away, take a deep breath and repeat quietly "Boy, this is fun."

Please, don't steal any of these ideas.

Tesla:

Bust The Smithsonian

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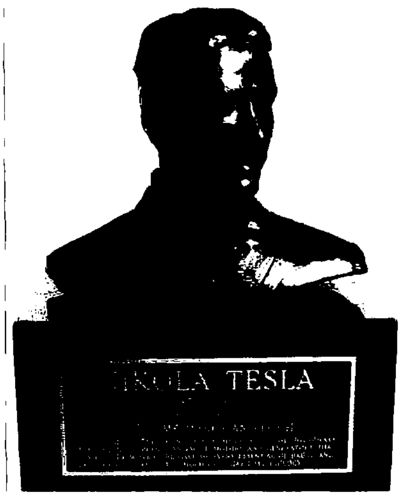
In the spring of 1983 I was browsing through the Allegheny College Library and found a book titled *Prodigal Genius, The Life of Nikola Tesla* by John J. O'Neill (1944). I had known about Tesla and his famous coil from my high school days 40 years earlier, but this was my first opportunity to learn more about the man whose coil made fascinating sparks. Regrettably, his coil was the sorrowful extent of my knowledge of Tesla, and likely it is as much as most people know, if indeed they recognize his name at all.

The first two pages of O'Neill's biography are powerful. After more than 12 years I can't forget his words. In short, I deem it a book of epic proportion. When I looked at the inside of the back cover, I was amazed to find that the book had been taken out only eight times in the past 38 years. How could this be? Was I overestimating the importance of its message? I didn't think so, and I still don't.

The same can be said for the next Tesla biography I discovered, *Tesla, Man Out of Time* by Margaret Cheney (1981). It has a powerful introduction by Leland Anderson, our country's foremost authority on Tesla. It is by far the most completely documented book available today on Tesla.

Class Hero

I had been teaching English Composition and my first thought was, "How interesting it might be for my students to learn the story of Tesla's life—it just might help me breathe some fire into their writing." The more I read, the more I was able to impart to my students, and the more they became inflamed with enthusiasm—not only for writing but for a desire to wave Tesla's banner. It seemed we had discovered a secret, if not an outright flaw in history. Why was it that so few people had



ever heard of Tesla? We decided to write letter stories to people and tell them about our discovery.

At first, and without realizing it, Tesla had become our class hero, and my students now became excited about writing. We developed a mission—to tell as many people as possible about Tesla. I was reveling at the writing successes in my classes, so I continued this activity with succeeding classes for several years.

One school year, 1986-87, was particularly exciting. Someone brought to our attention an interesting situation that existed in Madison, Wisconsin. We learned that several years earlier someone had named streets after famous scientists, including Tesla and Marconi. The city fathers spelled "MARCONI" correctly, but somehow they had misspelled Tesla's name as "TELSA" on their street sign. We also learned that a University of Wisconsin professor and chairman of the History Department had petitioned Madison officials to correct the spelling of Tesla's name, but his pleas to City Council were rejected repeatedly until he finally abandoned his crusade.

This was exactly the sort of challenge my students wanted and needed. We bombarded Madison with letters to City Council, the newspaper, residents on "TELSA" Street, the mayor, and even the mayor's wife, chiding them to correct Tesla's misspelled name. We argued, "After all, Tesla was an honored American citizen who gave much to the world;" and, "How would they like to see Washington's name spelled incorrectly on street signs?" The dispute raged for months and our story made the front page of the *Wisconsin State Journal*. One council member was particularly distraught over the issue. He called one day and begged in so many words that we "get off their backs." We refused to relent because we knew we had truth on our side. Five months later we received a letter from the City Clerk advising us they had corrected the street signs. This was confirmed later by a photograph one of my students took while traveling there.

One Saturday morning two years later my doorbell rang. It was a former student and her father. She told me that for the past three years she had not forgotten our Tesla story. It had made such an impression on her that she had persuaded her father, an accomplished sculptor, to render a Tesla bust for our class... that is, if this was something I really wanted. It took about a microsecond for me to agree to their generous offer. They explained that I would have to pay for the materials, but there would be no charge for the work. I was ecstatic and many thoughts ran through my head. We could put the bust in our classroom, or perhaps donate it to some museum.

When the clay model took better shape and I could see how magnificent it really was, the sculptor asked what preference I had for the final cast. We decided on bronze. We also decided on a granite base and a bronze plaque telling of Tesla's

eminence in the field of electrical science. I worked for weeks at my computer keyboard composing various inscriptions for the plaque and consulting Margaret Cheney and Leland Anderson for guidance. Finally, I decided to use the following inscription:

NIKOLA TESLA
1856 - 1943
HIS NAME MARKS AN EPOCH
IN A SINGLE BURST OF
INVENTION HE CREATED THE
POLYPHASE ALTERNATING CURRENT SYSTEM OF MOTORS AND
GENERATORS THAT POWERS OUR
WORLD. HE GAVE US EVERY
ESSENTIAL OF RADIO, AND LAID
THE FOUNDATION FOR MUCH OF
TODAY'S TECHNOLOGY.

There will probably be several readers who might wish that I had said something else on this plaque. Nevertheless, these were Tesla's greatest achievements.

Placing the Bust

My youngest son told me about a band in California named TESLA that might be interested in contributing to our campaign. I wrote to them. In a few weeks their drummer and a guitar player responded personally with a check for $1,800. In addition, we wrote to dozens of CEOs of power companies and large corporations. Many responded with checks of $50 to $100. It seemed we were making real progress because many people in high positions were sympathetic to our message.

As we struggled deciding where to place our bust, someone suggested the Henry Ford Museum in Dearborn. They have an entire section of their museum devoted to the history of electrical science. We believed they would welcome with open arms a bust of this caliber for their display.

When I drove to Dearborn to confer with their head curator, I showed him a large full-color photograph of our bust and told him our story about how it came into being. Then, on behalf of my students, I offered the bust fully expecting that he would accept it. After all, the bust was magnificent and had an appraised value of $6,000. I was struck dumb when he refused our offer. It was simply beyond my comprehension that such a prestigious museum would refuse to accept and display the bust of America's greatest inventor in electrical science. As I left the building, admittedly dazed, I noticed a huge model of the Statue of Liberty featuring an Edison display. The theme was a celebration of Edison for making possible the electrical energy needed to illuminate our national monument. It was apparent AC power was celebrated rather than Edison's incandescent lamp.

As I walked out the door I looked back, and there above the entryway I saw an inscription I had apparently missed when I first entered. It read, "The Edison Institute." Now everything suddenly fit into place. Edison and Ford were close friends, and it was reasonable to expect the Ford company would continue to celebrate Edison's name. I thought, "There must certainly be other museums that would not have this kind of bias," so I visited the Chicago Museum of Science and Industry. I concluded it was nothing more than a haven for commercial displays—certainly nothing to compare with, say, the Toronto Science Museum. Canada was out of the question though because we wanted to keep the bust in this country.

Finally someone suggested we go to the top—to the most august institution of them all, the Smithsonian. It is the one place in our country where only the greatest have their places in history preserved forever...men such as George Washington, Thomas Jefferson and Joseph Henry. Certainly their officials would understand and appreciate Tesla's stature.

"It was simply beyond my comprehension that such a prestigious museum would refuse to accept and display the bust of America's greatest inventor in electrical science."

I reasoned they probably had already recognized Tesla's accomplishments and might have a bust, so I decided to travel to Washington in 1988 to visit the Smithsonian's National Museum of American History. I had visions of seeing nothing but the grandest of sculptures and extensive displays. Upon arriving I discovered that the electrical section was closed for renovation. When I explained to officials my purpose of coming to Washington, I was treated to a personal tour of their archives by none other than the curator's assistant. He gave me a book describing their displays, but I was also able to see a part of the museum that was not open to the public. There were numerous busts, but none were so great as to make our bust seem inferior. Therefore, I saw no reason why the museum could possibly refuse it. I returned to Ann Arbor with the book under my arm and feeling as if my trip had been a success. All that remained was to make our formal offer and our project would be finished.

When the bust was finished, one of my students volunteered to write to the museum. In a few days we received a reply from Dr. Bernard S. Finn, curator of the Division of Electricity and Modern Physics. He did not want the bust! My students were devastated, and again I was struck dumb. He explained they 'almost never collect busts in their Division.' Later, a friend who had visited the museum and taken photographs sent me one revealing that Dr. Finn was displaying Edison's bust next to Tesla's first AC motor/generator. Tesla's U.S. patent number appeared on the motor/generator, but the display was arranged in such a way as to give credit to Edison. Needless to say, I was astonished.

Further investigation revealed we were not the first group pressuring Dr. Finn to recognize Tesla. Several years earlier a congressman had chided Finn to create a Tesla display. The display prepared by Dr. Finn consisted of a small glass showcase housing a few insignificant personal artifacts. The showcase was placed in a darkened hallway next to the men's room, while the main gallery was devoted to an elaborate Edison display.

By this time I had thoroughly read Dr. Finn's book, *Lighting a Revolution*, given to me by Finn's assistant when I visited the museum. My first *73 Amateur Radio Today* article (December 1995) describes Finn's section titled, "The Beginning of the Electrical Age," naming 43 contributors to the science of electricity. Tesla's name was omitted! This was particularly disturbing because, in describing the Niagara Falls Power Project, Dr. Finn alluded to Edison's genius that made the Niagara project possible: "When the Niagara Falls power station began operating in 1895, it signaled the final major act in the revolutionary drama that began in Menlo Park in the fall of 1879." In other words, in 1879 Edison invented DC electricity! Then, in 1895, he invented AC and harnessed Niagara Falls! The historical truth of this episode is that Edison fought the rise of AC and played no role whatever in the Niagara Falls power project. An acknowledgment on the inside of the book revealed that its funding was made

possible by the Thomas Alva Edison Foundation. I wondered if Dr. Finn's depiction of electrical history was highly biased toward Edison because funding for the book came from the Edison Foundation?

In *Science*, Vol. 245. July - Sept. 1989. p.768. a book review titled "The Real Edison, The Making of an Inventor," by Reese V. Jenkins et al., Eds. Johns Hopkins University Press, Baltimore, 1989, carries a most revealing observation: "This volume renders untenable the popular view of Edison as a Merlinesque figure who wrestles with mysterious forces and single-handedly conjures up stunning inventions."

My daughter teaches physics and chemistry at a nearby university. I asked her to involve her physics students in my campaign. They wrote numerous letters to the secretary of the Smithsonian besieging him to accept our bust. All responses were negative because the Secretary was determined to back Finn's personal bias toward Edison, amounting to the virtual exclusion of Tesla.

One of my students suggested we make promotional T-shirts and sweatshirts to sell. We decided to put a picture of our bust on the front. My wife, who is usually not vocal, suggested we use the caption, "BUST THE SMITHSONIAN." We engaged an artist to create a seven-color likeness of Tesla including several symbolic figures representing highlights in his life for the back of the shirts. The artwork and silk-screening would be complex and we could find only one firm in Ann Arbor able to do the work. The end product was magnificent! We sold hundreds of shirts in nearly every state, the proceeds going into a charitable account for two additional busts soon to be cast.

My next move was to write to U.S. Senator Carl Levin from Michigan, asking if he could exercise some of his political clout on the Smithsonian. Several letters were exchanged, but they had no apparent effect. Then, in one final effort, Senator Levin, on July 10, 1990, stood on the floor of the U.S. Senate and delivered a scorching account of the Smithsonian's historical debacle regarding Tesla (*Congressional Record*, Vol. 136, No. 86): "...Nikola Tesla has not been granted his proper place in history. In the Smithsonian Institution, for example, Mr. Edison's inventions are justifiably well represented. However, although the museum has included Mr. Tesla's alternating current generators in their exhibit, no mention is made of Mr. Tesla. In fact, the generator is included as part of the Edison exhibit."

At this time several Michigan newspaper articles telling our story appeared in Detroit and locally. Later, an Associated Press writer put the story in newspapers throughout the country. I even received one report the article was seen in a Hong Kong newspaper. All this publicity had no effect on Smithsonian policy. However, the secretary finally promised to have Dr. Finn create a significant Tesla display in 1993. Their plan was to commemorate the hundredth anniversary of the Columbian Exposition in Chicago. This was the first World's Fair, brilliantly lit by electricity—the same AC that powers the world today, made practical by Tesla's genius.

"If, on the other hand, a club or perhaps some students read this story and want to become involved, either by radio or on the Internet, they could make their feelings known."

I sensed that the secretary was only buying time and that some excuse would be found not to give Tesla his due. It was not long before my apprehension became reality. Dr. Finn was relying on obtaining a few Tesla artifacts held in a Yugoslavian museum. Soon thereafter the war in Yugoslavia erupted. Now Dr. Finn uses the war as an excuse not to create a Tesla display. The Yugoslavian museum items he deems so important for his proposed display are only insignificant artifacts...a suit of clothing, a cane, a pair of shoes, a suitcase, etc. Obviously, the public would not relate these items to Tesla's greatest contributions—his rotating magnetic field principle and his basic four-tuned circuit forming the necessary element of radio. Dr. Finn's plan is to explain Tesla as an eccentric loner who remained outside the arena of mainstream academe and industry. Would not science history be better served if he highlighted and paid tribute to Tesla's greatest contributions? These fundamental discoveries serve as the foundation for our two most important industries—power and communication.

It was Hans Christian Oersted discovering electromagnetism in 1820, followed by Michael Faraday making the first electromagnetic generator in 1831, that really opened the age of electric power. Tesla's rotating magnetic field principle indeed "signaled the final major act in the revolutionary drama"... but that drama began with Oersted and Faraday, not with Edison at Menlo Park!

How to Protest

The Smithsonian was criticized severely recently, and rightly so, by veterans groups and others for their wrongful depiction of history regarding the bombing of Hiroshima and Nagasaki. The outcry was so loud that Smithsonian officials had to modify their Enola Gay display. I see little difference in the historical bias the Smithsonian shows against Tesla and the nonsensical bias they preferred regarding the Hiroshima and Nagasaki bombing. Of course the main difference in these disputes is that Tesla does not have large segments of the general public complaining to Smithsonian officials.

When Wayne Green asked me to write a second article for *73 Amateur Radio Today*, I wondered who in the amateur community really cares anything about Tesla or the Smithsonian's depiction of electrical history. I also wondered what I might expect to accomplish by writing a second article. The logical answer to that question is, "probably nothing," because amateurs comprise a small group...certainly not even close to the size of a national veterans group. Therefore, I cannot expect a large outcry of protest to the Smithsonian. If, on the other hand, a club or perhaps some students read this story and want to become involved, either by radio or on the Internet, they could make their feelings known.

Unfortunately, the Smithsonian is a political organization, much the same as many other groups in Washington—they blow in the direction of the wind. I believe the wind has been blowing for too long in Edison's direction, particularly in regard to his entrepreneurial experiment with DC power. I want to see credit given where credit is due...to Tesla for his polyphase AC system...the system that works.

The History of Technology faction that has emerged in recent years has subverted our national museum and converted it into an advertising medium promoting specific industries that support them financially. Also, the group that has assumed power at the Smithsonian is methodically dismantling and converting our national museum into an instrument for social change. What was once a tribute to America is gradually

Continued on page 30

Tesla:
Continued from page 28

being transformed into an assault on American history. I strongly suspect these issues were not even imagined by Mr. James Smithson, a genteel and erudite Englishman, when he bequeathed his estate to the government of the United States to establish the Smithsonian "for the increase and diffusion of knowledge." Smithson was a scientist and man of letters, not a social activist. He undoubtedly envisioned a museum that celebrated creativity rather than entrepreneurship, and tasteful displays depicting an accurate account of our society's accomplishments rather than focusing on its problems.

One way of changing the direction that the Smithsonian has been heading is by voicing strong opposition to its head: Mr. Ira Michael Heyman, Secretary, Smithsonian Institution, Washington, D.C. 20560

Much of the change in focus at the Smithsonian started with its former head, Secretary Robert McCormick Adams who retired in 1994. It appears that Secretary Heyman intends to continue the course started by Mr. Adams. If any readers feel obliged to write to Secretary Heyman, I would be pleased to receive a copy of your letter.

Number 30 on your Feedback card

Telephone Flasher

Don't miss any more phone calls.

Chet Garrison W6ZZB
3544 E. Dayton Avenue
Fresno CA 93726

So, you're at your rig with the ear phones on and working some good DX when the telephone rings. You don't hear it and it is your wife at the beauty parlor and she needs a ride home. Boy! Are you in trouble!

It you had built the circuit In this article, it could have saved you from the dog house. This circuit, when connected to AC and the telephone line, will flash a light every time the phone rings. Of course you must have a phone outlet in your shack. Doesn't everyone?

The circuit is dirt simple and can be hard-wired or you can use the PC board accompanying this article. All the parts can be mounted on a 2" square circuit board and will fit into a "wall transformer" case from which the transformer has been removed. However, I'll leave the cabinet or enclosure choice to you.

In my case, I chose a 48-volt SPDT relay because the ringing voltage is approximately 48 to 50 volts.

Parts list:

Relay 48 volt SPDT Part # R22-5D16-48, NTE Electronics Inc. (may be ordered from Radio Shack)
C1 1 µF, 200 volt, non-polarized
C2 10 µF, 50 volt
Rectifier Full Wave Bridge RS # 276 1152

Miscellaneous AC oulets and plug and telephone wire with the proper termination.

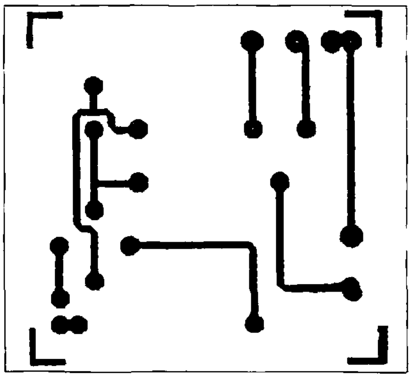


Fig. 1. The foil side of the board.

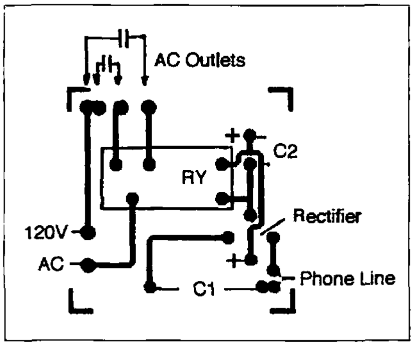


Fig. 2. The component side of the board, showing parts placement.

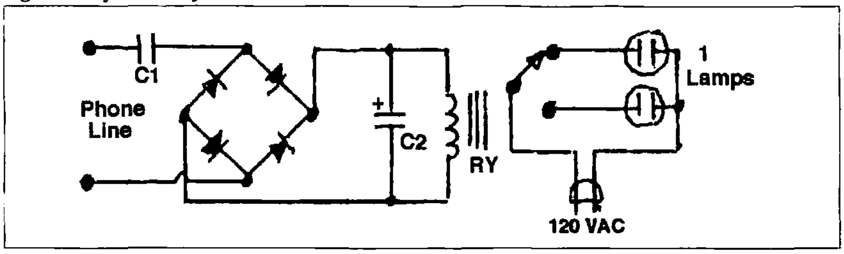


Fig. 3. The circuit diagram.

Free Electricity

Is it worth the price?

Mike Bryce WB8VGE
2225 Mayflower Ave. NW
Massillon OH 44647

Photovoltaics, electricity from the sun, is the ultimate source of energy. It's a clean, nonrotating, renewable source of electricity. Hams have been taking advantage of solar energy since the first surplus cells appeared on the market.

I have been using the sun's energy since 1978. I've designed thousands of systems worldwide through my SunLight Energy Systems company. However, my personal favorite just happens to be located a few miles from my home. It's the home of Clyde "Chuck" Davis WA8YGU. Chuck, like me, has always been interested in solar power. Pushed by the ever increasing cost of electricity from the power company, environmental concerns, and self-sufficiency, he contacted me. Let's take a closer look at his "system" and how it came to be.

Design Goals

Chuck wanted a system that would power his entire home. Some of the loads included were the furnace, washer/dryer, refrigeration, and a small air conditioning unit. Chuck also operates a 24-hour landline-based BBS. Several computer calculations showed that the amount of energy required per day was about 50 kW/hours. At the current cost of grid supplied electricity, Chuck's average monthly electric bills were peaking about $160 a month.

Since most of the loads specified were AC, all loads would operate from a DC-to-AC sine wave inverter. A sine wave inverter was chosen since several of the AC loads would operate unsatisfactorily under the modified square wave some inverters use.

The Solar Panels

Most hams would look for the cheapest solar panels. In a design like this one, there were several other factors that had to be included. Aside from the actual cost of the panels, we had to take into account the required panel mounting structures and the labor required to install the panels. Smaller wattage panels, while less expensive, require more mounting space for a given amount of power. The added cost of interconnecting wires and cables also had to be taken into account.

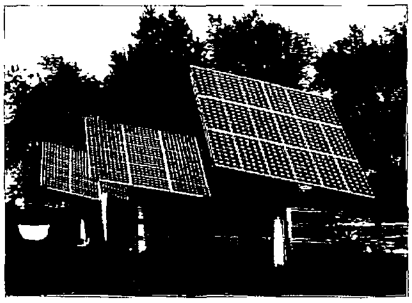


Photo A. The three arrays keep the battery bank fully charged, providing all the power needed for the home and hamshack.

On my first rough draft, I suggested two types of panels. The first was the Solarex MSX-64. This polycrystalline panel produces 64 watts under standard test conditions. Its large extra-heavy frame makes it an ideal unit to use in our local climate. It uses standard 1/2-inch electrical conduit, making the interconnection between modules neat and easy. And it comes with a 20-year warranty against power loss.

The second module I recommended was the Siemens ProCharger PC4-JF. It's made of single-crystal cells and produces 75 watts under standard test conditions. As with the Solarex panel, the PC4-JF will also accept standard electrical connections via its junction box. It also has a built-in bypass diode. This is different from a blocking diode in that a bypass diode will shunt current around a shaded panel, protecting it from damage. It has a 10-year warranty against power loss, and costs less than the Solarex panels.

Chuck decided to go with the Siemens modules. Given an array of 18 panels, the difference between the two would be a total of 190 watts! That extra 11 watts each panel produces would equal more than two MSX-64 panels, when configured in an 18-panel array. With a planned three arrays, that's an extra nine panels at a cost of zero dollars.

Naturally, right after the first PC4-JF had arrived, Solarex announced a new, higher-power version in its MSX "MEGA" series. Had the new MSX-83 (83 watts vs. the 75 watts of the PC4-JF) been available, then the MSX-83 would have been our choice.

There are 18 panels in each array. The panels are wired in series to provide a 24-volt system. The system voltage was determined by the inverter, as I'll explain later on.

Each subset of 24 volts is wired in parallel with the rest of the array. So, of the 18 panels, 9 are in series and 9 are in parallel. Each array then produces a total of 918 peak watts. That breaks down to 27 amps at 34 volts. The entire system produces just short of 3kWpa (peak array).

All three arrays are wired the same. The power from each array is combined in junction boxes at the base of arrays #1 and #2. From the junction box, there are four runs of four-ought weld cable routing the power into the battery storage area. Along with the power cables, several runs of "data" wires were also pulled though the 4-inch underground conduit. In the future, these data wires will connect to different sensors, providing such data collection as array cell temperature, wind direction and speed, as well as individual array current.

Each set of 18 panels is mounted on a dual-axis solar tracking mount. Dual-axis means the mount will track the sun

from east to west and north to south, all at the same time. At dusk, the "trackers" automatically reset back to the east, awaiting the sun's return the next morning. Each tracker is driven by two small electric motors.

A small battery operates the motors at night so the array is pointing toward the east.

Controlling the Power

Under a bright, clear sky the three arrays will produce over 118 amps continuously. Peak current has been noted at over 125 amps. A Heliotrope General CC-120E was used to control the current to protect the batteries.

This controller is state-of-the art in power MOSFET design. Using PWM (pulse width modulation), the power MOSFETs keep the battery bank from being damaged by overcharging. Although the CC-120E is specified for 120 amps, the first unit did not survive. After consulting with Heliotrope General, we decided to add additional heat sinking to the controller. This heat sink consists of a half-inch thick aluminum plate about four feet square. In addition to the aluminum plate, several sections of a large extruded heat sink were also attached to the plate.

The CC-120E has an internal cooling fan controlled by the temperature of the blocking diodes. The fan will run when the case temperature reaches 100°F. At no time has the automatic thermal shutdown stopped the CC-120E.

Battery Storage

We used good ol' lead-acid batteries, wired in a 24-volt system. The bank consists of 24 6V golf-cart batteries. Each battery has a capacity of 220 amp/hrs, so the battery storage bank has the capacity of 1320 amp/hrs at a 20-hour rate of discharge.

Loads

A Trace 2420 sine wave inverter supplies AC to all of the loads. So far, there has not been any load that the Trace has not been able to handle. This includes a deep well pump and various refrigeration units. The Trace has an internal DC charger, but this feature is not being used. With automatic shutdown from everything from a low battery to an overtemp condition, the Trace has been working without a glitch since day one. It has also managed to survive several very close lightning strikes, when it would shut down, wait a few minutes and then restart.

The Trace inverter, at the time the system was being designed, was available only for 24 volts. It is now available for 48 volts. Had that unit been on the market, I would have chosen it, which would have reduced the cost of the welding cable used to bring in the power from the arrays.

System performance

The system has been online for over a year and has produced over 4 *million* kW hours.

Two of the dual-axis trackers failed, but they were replaced by the manufacturer. Since the replacements were installed we haven't noted any problems with the trackers.

With the dual-axis trackers, in the summer months the array-to-load ratio is over 10:1. This means there is slightly more than twice the array capacity than load demand. The battery bank can be depleted to 50 percent at night and be fully recharged by the middle of the next day.

During the winter months, the array-to-load ratio is a break-even 1:1. The battery storage is sized a bit too small to operate all the loads during the winter. Increasing the battery size would provide greater running time, but it would also increase the time required to fully recharge. In the summer, Ohio averages over seven hours of sun per day when using the dual-axis trackers. However, in January we average only three hours.

Things I Would Change

My original design did not specify the dual-axis trackers. I had specified a seasonal adjustable top-of-pole mount. In this location of Ohio, the trackers will not produce much additional power during the worst part of the year.

In January, the sun sits too low in the south for the trackers to do much good, but Chuck had to have them.

I had originally specified Trojan L-16 batteries for the battery bank. Chuck decided against them from two reasons. First, new 6-volt lead/acid golf-cart batteries were available for $38 each from a local source. The L-16s, on the other hand, were $190 each. The L-16 is also 6 volts.

The golf-cart battery weighs about 70 pounds. The L-16 is 120 pounds. Since the batteries are in the basement, each battery would have had to be carried down by hand. Of course, when a battery went bad, it would have to be carried up as well.

Why not use a different battery? Well, ideally, a forklift battery would have been my first choice. The problem is, you need a forklift to move one! We considered NiCd batteries, but their cost put them out of the question. When the current batteries need replacing, we may use large 2-volt sealed lead-acid batteries.

The Bottom Line

What is the payback period? Well, the whole system cost about $35,000. Had Chuck gone with the top-of-pole mount instead of the dual trackers, he would have saved $7,500. And using L-16s instead of the golf-cart batteries would have cost him about $2,000 more.

As for the payback period? Well, Chuck will more than likely never see the system pay for itself. However, several months after the first array went online, Chuck's electric bill dropped so much Ohio Edison sent out a troubleshooting crew.

Still, not counting any maintenance of battery replacements, Chuck is looking at around 15 years before he breaks even.

Caveats

Electrical space heating and refrigeration are two loads that should be run on a source of energy besides PV. In this case, Chuck is running both air

Continued on page 83

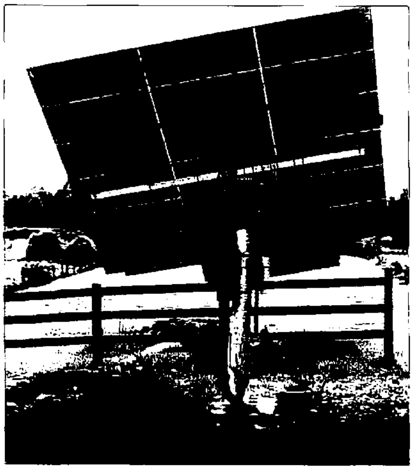
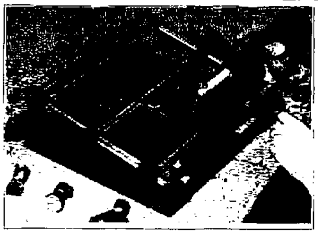
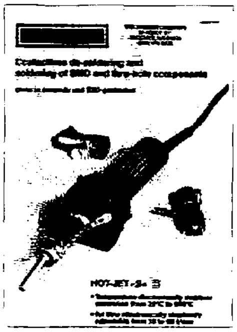


Photo B. *The array is supported by an 8" pipe which is seated in five feet of concrete.*

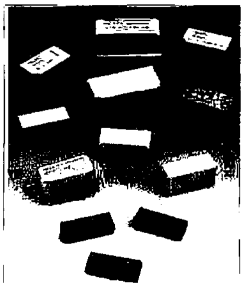
NEW PRODUCTS





Leister/Malcom

Leister sells hot air equipment for welding, drying, curing, shrinking, desoldering, and soldering. The leaflet includes color photos of the new Leister Hot-Jet "S", and is available from The Malcom Company. To find out more, circle Reader Service No. 201

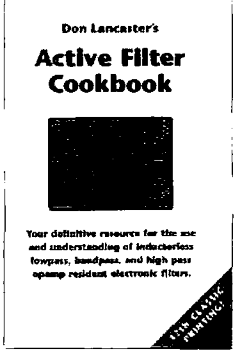


"World Class" Relays

GEM Electronics, Inc.

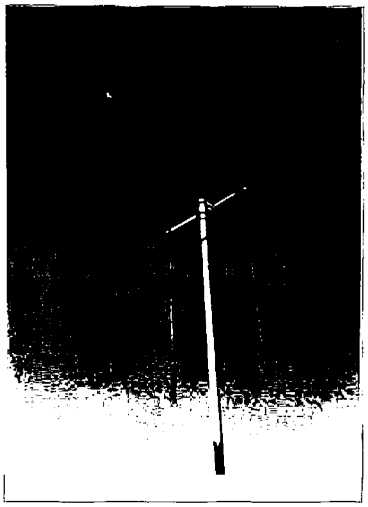
Need a Data Sheet on a particular relay, or some general information on relays? GEM Electronics can help you with their line of Meder Electronic Relays. Circle Reader Service No. 203.

Active Filter Cookbook



Microcomputer guru Don Lancaster has been at it again with this 17th edition. So what's an active filter? It's a combo of op-amps, resistors, and capacitors which replace traditional bandpass and high-pass filters with something smaller, less expensive, easier tuning, and simple in design. The book runs 240 pages and is packed with enough application circuits to keep a builder happy for months. It's $28.50 via better book stores or from Synergetics Press, Box 809G, Thatcher AZ 85552. Circle Reader Service No. 208.

Cubex Antenna Company



The CUBEX Antenna Company has produced the "BUMBLEBEE" 6m 2-element quad antenna. It is all fiberglass with a heavy duty aluminum mast to boom coupler. The antenna is fed directly with 52-ohm coax and features the exclusive CUBEX tuning block that allows the antenna resonance point to be adjusted so that the entire 6m band can be used without completely changing the wire elements. The antenna comes with the driven element pre-marked for a resonant frequency of 50.4 MHz, giving the antenna a bandwidth of 1.5 MHz at an SWR of less than 1.7 to 1. The antenna can be rotated for horizontal or vertical polarization, and has a boom length of 27 inches. The best feature is the price of $69.95 F.O.B. BREA CA. PLUS $12 S & H. Circle Reader Service No. 202.

NCG COMET

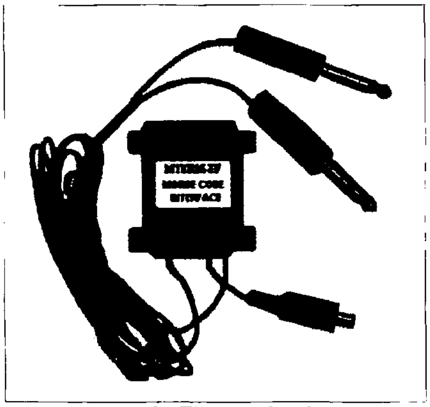
The COMET "Quick-Disconnect" Mobile Antenna Mount, Model CQ-5M consists of two separate sections: A trunk-mount base that is attached to the trunk edge with four set screws, and an antenna-mount base that fits inside the trunk-mount base. Sliding a lever wedges the antenna-mount base securely in place. To remove the antenna, simply slide the lever to unlock. The antenna can then be placed inside the trunk. Comet's 17-foot deluxe coax cable assembly is included. The first 12 inches of coax is RG-188A/U style, allowing easy entry into the trunk without causing cable damage or starting a water leak. The coax balance is double shielded, low loss, with gold-plated connectors.

Two offset washers rotate around the antenna connector to adjust the antenna to the vertical position. The bottom of the trunk mount base is rubber-coated to prevent paint damage. It has a wide foot print to support large antennas. Two versions are available: CQ-5M has an SO-239 antenna connector, and a PL-259 transceiver connector. CQ-5N has N-type connectors. Contact your local or favorite amateur dealer. List price is $66.95. For more info on COMET products, and a complete catalog, contact the NCG Company at (800) 962-2611, or circle Reader Service No. 204.

MCM Electronics

MCM Electronics, an industry leader in the distribution of consumer electronic repair parts and accessories, is introducing their *free* catalog, No. 36.

The catalog contains over 2,700 new items, including project accessories, semiconductors, connectors, test equipment, computer products, audio, TV, VCR, and appliance repair parts. This catalog also introduces LAN cable test products from Paladin and Triplett, quality crimping tools from Sargent, and many other new items for the electronics service technician. Catalog 36 also announces permanent price reductions on semiconductors, video heads, flybacks, motors, and other items used in consumer electronics service. Circle Reader Service No. 207.



Dynamic Electronics Inc.

Dynamic Electronics Inc. is pleased to announce a new Morse Code Computer Interface that allows sending and receiving the International Morse Code with an IBM-compatible computer. The interface electronics is contained in a DB-25 housing which can be connected to any COM port on an IBM Compatible Computer. An adapter can be used for 9-pin COM ports. A 1/4" plug is included for the "phone" jack and a 1/4" stereo plug is included for the "key" jack of a transceiver. A stereo-mono adapter (not included) can be used for 1/4" mono "key" jacks. A 900-Hz audio filter with a noise subtracter is included. An RCA-type phono jack is available for connecting the processed CW to the high impedance input of an audio amplifier. The speed is automatically tracked on receive. The code is converted to ASCII characters and displayed on the screen. The station can be left unattended and messages can be saved to a disk file when a call sign match is received. A Call Alert feature will allow the computer to sound an alarm when a call sign match is received.

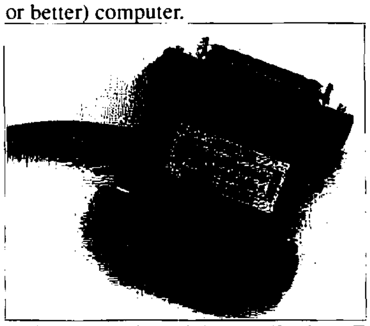
Transmit features include a type-ahead keyboard buffer, and the options of sending from any of the 8 preprogrammed messages, or from a disk file. The transmit speed can be varied from 5 to 100 wpm. A message can be automatically sent at a future time without the operator being present.

Software is supplied on both 5.25" and 3.5" diskettes. The cost is only $79.95 plus $3 shipping. Payment can be made by checks, VISA, or Master Card. For more information, circle Reader Service No. 206.

Advanced Electronic Applications, Inc.

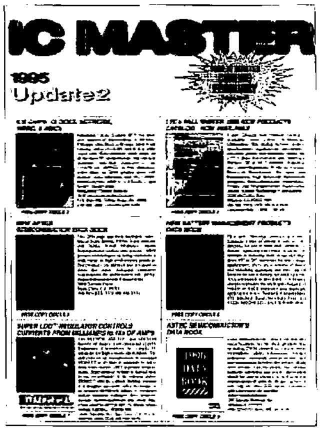
AEA recently introduced the new AEA ACARS package for receiving aircraft digital communications. AEA ACARS is a package containing a small demodulator cable and DOS computer software that, when attached to a scanner or receiver, lets you decode the digital communications taking place between ground stations and aircraft. ACARS is a digital data link system designed to enhance air-ground-air communications. If you are near a major airport, you can even monitor both air-to-ground and ground-to-air digital communications.

All you need is AEA ACARS, a VHF receiver or scanner capable of covering 129-132 MHz AM, and an IBM-compatible (386 or better) computer.



There are three versions of AEA ACARS: (1) the entire package which includes the demodulator, software, and detailed manual; (2) the AEA FAX ACARS Upgrade—so AEA FAX owners can get the software-only version of AEA ACARS to use with their current demodulator; (3) the AEA ACARS 900 package. AEA PK-900 owners already have the hardware built into their data controllers. All they need is this special software-only version of ACARS designed to work with the PK-900. AEA ACARS is available from your favorite amateur radio equipment dealers. For more information on AEA ACARS, call AEA's literature request line at (800) 432-8873, or fax requests to (206) 775-2340. Advanced Electronic Applications, Inc., P.O. Box C2160, Lynnwood WA 98036. Or circle Reader Service No. 205.

IC Master



The new IC Master Catalog is coming out in February on paper, and on CD in March. With over 120,000 different *kinds* of integrated circuits sold by way more than 250 manufacturers around the world, you need something to help you stay oriented. IC Master is a comprehensive reference full of product information. The CD comes in DOS and Windows versions (sorry, Mac users). The Windows version even includes packaging and pin-out information.

The new catalog will have info on more than 20,000 first-time-listed devices, including over 460 new op-amps, 6,000 new listings for memory, 2,000 new digital, and 500 new processors/controllers.

As valuable as the above information is, you can also order several smaller catalogs and other literature from manufacturers for free from IC Master, such as the Datel DC/DC Converters Catalog, the Astec Semiconductor's Data Book, and the Semtech Battery Power Management Products Catalog.

Order before the January 31st deadline and you can get the 1996 IC Master CD-ROM PLUS for $210, which is $25 off the reduced regular subscription price. Circle Reader Service No. 209.

73 Review

Number 38 on your Feedback card

Add-On 2 Meter Receiver Selectivity

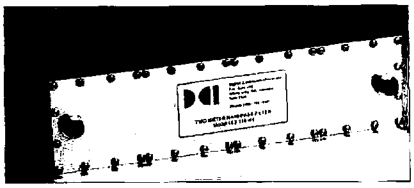


Photo A. The DCI-146-4H 2 meter bandpass filter.

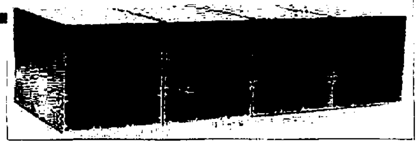


Photo B. The interior of the unit.

Bill Clarke WA4BLC
764 Alta-Voor Road
Altamont, NY 12009

With the proliferation of radio signal producers, both those that are supposed to radiate signals and those that do anyway. 2 meters has become a chore to listen to in many RF-dense areas.

An RF-dense area can be a metropolitan area with loads of pagers, commercial repeater services, cable TV, and/or computers. It can also be a rural mountain, loaded with broadcasters and leased repeater services.

Types of Interference

Nearly everyone using 2 meters has experienced some form of interference at one time or another. Generally, the interference experienced will consist of:

Signal suppressing or blocking—caused by a strong RF signal which desensitizes the receiver, making it incapable of receiving the desired signal. Such signals are from transmitters on "near the 2 meter band" frequencies. A good example is the large number of paging systems located just above the two meter band.

Sidelobe interference—occurs when a signal on a nearby frequency (not within the receiver's passband) bleeds into the region of the passband and blocks the receiver.

Intermodulation—usually referred to as intermod or IMD, is caused by two or more signals from outside the receiver's passband mixing internally within the receiver, then blocking or otherwise interfering with the receiver's operation.

Using a filter such as the DCI-146-4H can reduce instances of these types of interference, often totally eliminating them.

The DCI-146-4H filter consists of four helical resonators mounted in a very solid chassis with two coaxial cable connectors. Helical resonators can be thought of as very high-Q RF circuits, passing only a very narrow band of signals. In the case of this particular unit, that passband range is 144 to 148 MHz. The skirts are quite steep, as shown in the chart, and provide up to -62 dBm reduction in signals outside of the filter's passband. The DCI filter is passive and requires no outside power source. You receive and transmit through it with power levels up to 200 watts.

This type of filter (very narrow passband) allows the receiver to be undisturbed by most out-of-band signals, providing for increased sensitivity and clearer reception.

Specifications

Passband:	144 to 148 MHz
Passband loss:	<1 dB
Selectivity:	-62 dB at 136 MHz
	-50 dB at 156 MHz
Power rating:	200 watts
VSWR:	1.5:1
Dimensions:	12 x 3 x 5 inches
Weight:	2 lbs. 11 oz.

The Test

To give the DCI 2 Meter Bandpass Filter a real-world operational test, I took the unit to a nearby mountaintop where there is an abundance of commercial FM and TV broadcast transmitters and various commercial repeater systems (on all bands). In this particular area, the S-meter (which is an LED bar graph on my 2 meter transceiver) dances all over, and, although the squelch is not broken at all times, the receiver is quite desensed. Even relatively strong stations cannot be heard well.

The test results on the mountain were quite positive. Only the slightest indication of intruding signals on the S-meter could be seen, and that was very sporadic. No noticeable degradation of signals was noticed, even when working distant repeaters and weak simplex stations. A quick removal of the filter gave instant proof that the filter really works, as without the filter the S-meter came alive and the distant stations were lost.

On the test bench I found that the unit's passband was a very close approximation to that indicated in the manufacturer's literature. Due to the very steep skirts of the DCI-146-4H, I doubt CAP and MARS users could use the filter. The SWR seen during transmit rises very quickly as you move out of band. During static testing I used a commercial dummy load and input power of 50 watts, although the filter is rated at 200 watts. Of note: No heating of the filter was observed during testing.

As a final operational test, I went near the transmitter site of a paging company that operates just above the 2 meter band. Using an HT connected to my mobile 2 meter antenna, I found the receiver to be blocked a large percentage of the time and the S-meter dancing a jig. I connected the DCI-146-4H into the antenna line and the problem ceased, with only a small amount of S-meter jumping noted. This type of setup should help the commuting ham using a handheld in RF crowded areas.

Comments

Installation is simple: Just put the DCI-146-4H in the antenna line by using

a short jumper cable. The filter will do its job without any operator control—install and forget. Due to its size, you might wish to remotely mount the filter—just keep in mind that you want a reasonably short patch line from the rig to the filter. Firewall mounting appears to be practical on some vehicles (where there is space). Other choices are under a seat, in the trunk, etc. There are no mounting holes on the unit, and *do not drill any!* My recommendation for mounting is:

1. Use plumber's strap over the unit and fasten the strap to the mounting surface with sheet metal screws.

2. Attach the unit to a surface with silicon glue.

The DCI 2 meter filter makes up for the wide-open front ends found on most 2 meter transceivers (wide-open meaning the receivers easily receive 135 through 170 MHz). When using the DCI-146-4H, effective receiver sensitivity outside the 2 meter band will be greatly reduced.

Too bad someone cannot design a filter that will remove all the computer hash heard around shopping centers, bands, and the like.

Availability

The DCI line of helical resonator filters is available at most ham radio stores and from DCI Digital Communications, Inc.

Note that DCI Digital Communications also produces filters for the 220 and 440 amateur bands. Commercial filters areavailable—call for specific applications.

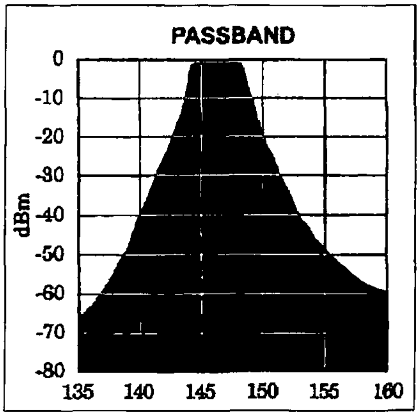


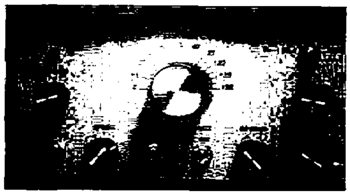
Fig. 1. Graph of the unit's passband.

73 Review

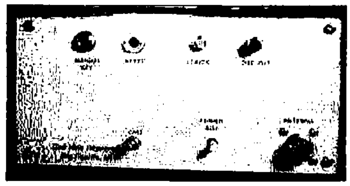
by Dean Lewis WA3WGV

Oak Hills OHR-400 4 Band QRP Kit

Ah! the joys of building!



Front OHR-400



Back OHR-400

Jeff M. Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

I had not built a kit in awhile and my personality had started to deteriorate proportionally. I seemed to have forgotten how therapeutic the building process is for me. I started to rationalize that I have built one of everything and that placing components on a board was just not as much fun as it used to be. I couldn't resist the temptation when I heard about the Oak Hills fourbander. Four bands, three of my favorite (20, 30, 40 meters) and one that I need to spend some more time on (80 meters) anyway. So I told the XYL I needed some money for counseling, and sent off for the kit.

I anxiously awaited the arrival of the kit. My children are now pretty well grown up, no grandchildren in the near future, so I guess this is the closest I can come for the time being to an anxiously awaited arrival. I got home from work on Friday afternoon. This was a real big weekend for me. Three days off and the weather was supposed to be nice for the first time in eight weeks. What more could I ask for? I came home from work and there was the box from UPS that I had been waiting for. Having significantly matured (if you can believe this one), I went and changed out of my work clothes before taking the prize to my workshop to unpack.

The first thing I noticed when opening the box was how carefully and professionally it was packed. All of the little components were packed inside the case and sealed so that you don't accidentally throw them away. There are three printed circuit boards, not counting the optional keyer. The boards are the absolute best I have ever come across (I have seen some as good, but none better). They are solder masked and have a terrific silk-screening. There is *no* question which parts go where. The receiver board has the parts fairly well packed, so the very high quality silk-screening is a definite plus.

Another thing I have noted is that Dick from Oak Hills really listens to his customers. This is evident with the documentation. The documentation comes in several sections which are individually stapled. The printing is top quality and easy for even my old eyes to read without the need for those new reading glasses (so in essence the kit makes me feel a little younger). The first section of the documentation is the Assembly Instructions. Oak Hills has a couple of pages on things you need to be aware of to make your building experience more pleasant and more likely to have you succeed with the project. The instructions are step by step, but not in the hand-holding "put this part R3 in hole in section 1A" way Heath used to do it. I really appreciate the clearness of instructions and not having to read and reread something many times to figure out if what I read and thought I understood is what the writer meant for me to understand.

Working with technical writing in the computer field, I realize how hard it is to write good instructions. Oak Hills also has started to include very professional diagrams for the final assembly in with the documentation. There are separate sections for each board that list all the components, a schematic, and an excellent, enlarged overlay. One of my main criteria for pleasure in building a kit is knowing what the author really means when building instructions are given. I feel it takes some of the therapeutic value away from the project when there is ambiguity in any of the steps.

The parts for each board come separately wrapped. This is another example of Oak Hills' listening to the customers. For each board the parts are separated by type, such as resistors and capacitors. I usually hate the first stage of building, which involves the sorting out of the parts and checking to make sure that they are all there. It used to take a great deal of time to separate and label the parts. Now I use little plastic parts bins and dump the resistors in one, the capacitors in another, and so on. I find it fairly easy to then use my magnifying glass (even Oak Hills couldn't solve this problem for me) to make sure I get the right part when I start stuffing the board. I find that after a few minutes of separating out the parts and documentation I can get into the project fairly quickly.

The cabinet for the kit is also very high quality and has a great paint job. The panels are beautifully screened. I believe them to be as good in quality as the major transceiver manufacturers' cabinets.

There are two distinct and equally important aspects of a kit for me: how much fun it is to build and how much I like to operate it when it is done. I have found that there are sufficient variables involved in implementing a kit design so that even the best designs may not work as they should when they are built. Some rigs are just more fun to operate than others. I finally took some time recently to ponder this aspect of my building experiences. I have built about every kit on the market in the last three years. I can pinpoint exactly what constitutes a pleasurable building experience for me. The parts in the kit have to be high quality;

the documentation has to be clear, tested and revised to eliminate errors, with no ambiguity at all; the printed circuit board needs to be high quality and clearly screened; and there should be separate parts lists by circuit board, with a clear enlarged parts overlay.

The fun-to-operate part is much more nebulous. This aspect is very personal. I have come up with a scientific method to determine this aspect. It is really quite easy. I have many rigs on my workbench. The number and type seem to change constantly. I find there are some rigs that I just keep using after the initial testing and evaluating. The reason for this is that they seem to me to work better and are more fun to operate. I put my Norcal 40 in this category, as well as the Oak Hills kits I have built. I think it is pretty amazing that small companies like Wilderness Radio and Oak Hills can put out such high-quality kits. They work very well as long as they are assembled properly.

Building

I found no unwanted surprises while building the kit. I built up the three boards and put in the optional iambic keyer. All went together quickly, even though I checked my work very carefully to make sure the correct parts were in the proper places on the printed circuit board and also checked all of my soldering joints with a magnifying glass. It can take quite a few hours to trace problems such as diodes or electrolytic capacitors being put in the wrong direction, or having the wrong values of resistors or capacitors placed on the board. It is much more economical and pleasurable to take a few extra seconds for each part and verify that they do indeed belong at a particular location. The board was a pleasure to solder. The plated through-holes are very easy to solder and make for strong connections. These also complicate unsoldering, so make sure you have the right parts in the right holes! If you should make a mistake (most of us do), I recommend a good quality solder sucker (can be purchased at Radio Shack) and with this board some solder wick is helpful.

Testing and Alignment

It was another Friday evening and the end of a really tough week. I am supposed to take my wife out for dinner, and my son is already at a friend's house for the weekend. Sounds like a good time for a romantic weekend...well, there was one problem. I was super-stressed from the week's events. I was in dire need of a "therapy session."

I did my mandatory chores, changed to my "play clothes" and went into the shack. I went to the bench and checked the Oak Hills Research 400 that I have put hundreds of parts into and over 50 wire connections and mounted many mechanical connectors, switches, and jacks.

The project passed the initial smoke test. I was very relieved when nothing sizzled on power up. I then took out the alignment procedures and was ready to roll. If you don't have the proper equipment or can't get it aligned, Oak Hills will align the completed rig for $65, including shipping it back to you.

The initial frequency setup went very quickly. Three of the four bands came up exactly on frequency with no adjustments necessary. Getting the fourth on frequency was a matter of adjusting a trim capacitor. It was very easy, using a frequency counter as is suggested. I switched back and forth between the bands and the oscillator for each band started with no problems. The only time-consuming adjustment involves adjusting a coil and a trim capacitor to get the correct bandwidth out of the VFO. I also like to get it so the dial reads near the real frequency. I didn't encounter any difficulties with this part.

You next adjust two coils on the oscillator board for each band for peak signal voltage as measured on a scope. I later found that I did not tune the 20 meter band coils correctly. I noticed this when I tested out the rig and found the SWR was high on 20 meters, even though I knew I was using a resonant antenna. There were two peaks for the coils, using a scope to monitor. You need to check to make sure you peak them on the correct frequency, as stated in the manual. On 20 meters I noticed that when I was peaking on the wrong frequency the power output went up to about 10 watts on my QRP wattmeter, but was right in range at the designated frequency.

Your next step is to move to the receiver board and adjust the voltage at a given point using a trimpot. That is all you do on that board at this time.

Moving on to the TX/REC board, you tune a set of coils for each band to get maximum signal output as measured on a QRP wattmeter. The two coils interact so that you need to go back and forth a few times. I noticed that 20 meters wasn't putting out a full 4–5 watts. I found that I had the power supply turned back to about 9 volts. I turned the supply up to 13 volts and the power came right up. All the bands tuned up easily and I got the correct power output on each band.

Photo A. The OHR-400 QRP kit is sensibly packaged and logically arranged.

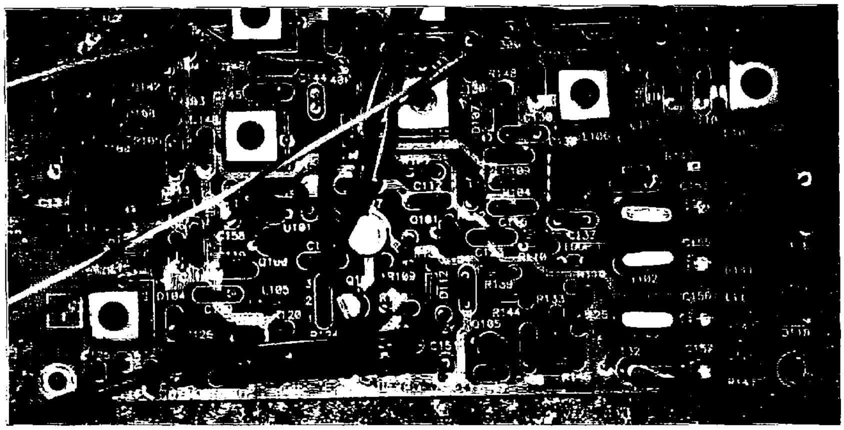


Photo B. "The boards are the absolute best I have ever come across. There is no question which parts go where."

The rest of the alignment went fairly quickly (well, I actually missed dinner and was in the doghouse for a while, but it seemed like only a few seconds). You adjust a trim capacitor on the receiver board to get the signal centered in the right place for the audio filter. The directions are quite clear and should be followed carefully. You then only need to adjust the sidetone level and one more trim capacitor to make sure that you are transmitting and receiving on the same frequency. Another transceiver is a good tool for this. If you have installed the optional keyer there is a simple adjustment for the iambic keyer weighting to get it to your preferred setting.

"I would recommend this kit very highly to hams that have a building project or two under their belt . . . "

To finish fine-tuning the receiver I decided to take it to my operating bench and hook up an antenna. I put the rig on 20 meters using a gel cell for power. As I was connecting the antenna I heard EA3DKR calling CQ. I finished connecting the antenna quickly and gave him a call. Carlos came right back to me. Who needs all those other alignments? He was a 559 and gave me a 559. My two-element quad may have helped a little. I worked an LZ1KOZ through a pileup almost immediately after working Carlos. Next I switched to 40 meters and had a long rag-chew, then back to 20 to work some more DX. I worked a Cuban station off the back of the beam.

Later in the weekend I worked UX3FW, Yura, S59AA, in Izmail, Franc SP3WYQ, George T77BL in the Republic of San Marino (it took awhile to figure out where that was), and Franc 9A2HF. I also did some rag-chewing on 30, 40, and, yes, 80. One QSO on 80 meters was an hour long. I hadn't worked 80 in quite awhile and was very pleased with how well the rig worked with 5 watts on this noisy band.

I received comments like "Your new rig sounds great," "Did you say QRP?," "Congratulations, QRP, sounds FB, Jeff!" (this guy started at 100 watts and we ended up going QRP–QRP on 80 meters), "solid copy." The last guy I talked with went on and on about how good it sounds. I worked anyone I heard, even DX that was real weak. I had nice long QSOs with no problem, on every band.

The rig was putting out about 4 watts on 20 meters and I turned the power back to 4 watts when using the other bands. Listening to the OHR-400 on a commercial transceiver, I found it had a really sweet note.

I noticed on 20 meters the SWR was just a little higher than it should be. I took out the alignment tool that was provided and adjusted the oscillator board coils for 20 meters. It brought the SWR right down to 1:1 and the rig was putting out 4 watts as it was supposed to.

I had the covers off a number of times during the weekend. This is standard operating procedure for me. It usually takes me a few times to get things set up the way I like them. I guess you could say I am a "tweak freak."

The receiver is sensitive and selective and quiet. The VFO is very stable. The audio filter and RIT work well. The QSK is fantastic, very quiet and quick. The optional Curtis keyer works fine. The audio is enough to drive a nice size Radio Shack speaker. The transmitter has a variable power control so you can work very low power if you choose to. You can adjust the power from about 5 watts on 20 and 30 to about 8 watts on 40 and 80 to close to zero.

I must say that I really enjoy operating this little rig. There is an intangible variable that I have with both the building and the operating of one of these kits. I call it the enjoyment factor. The building of this gets my top rating. A great deal of time and energy went into making it a very pleasurable experience. Does this mean it is perfect? By no means. I could spend time criticizing minor aspects, but they were minor enough that they in no way detracted from the building experience or my operating experiences. I would recommend this kit very highly to hams who have a building project or two under their belt, or even to a new builder who may want to get a little help with the alignment. There is great pleasure and satisfaction to be had when using a rig that you built yourself and that works very well.

Specifications: 80-40-30-20 Meter Bands

Receiver
- RF preamp
- Diode ring mixer
- Selectable AGC manual gain control
- 4-pole crystal ladder filter
- Selectable 4-pole audio filter
- Very stable VFO
- VFO covers 150 kHz each band
- RIT ± 1 kHz

Transmitter
- 4–5 watts all bands
- Adjustable from rear panel 0–full power
- Smooth QSK circuit
- Sidetone generator with level adjust
- Both iambic and manual key jacks

Kill Your Interference

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This subject has been so well covered over the years that I can't adequately bibliograph past articles. Yet, I still hear a dozen times a week from hams, both old and new, that they can't operate various bands (or at various times, or whatever) because they cause interference to televisions, radios, telephones, intercoms, compute modems, fax machines...you name it.

Hey, folks, this is 1996. We're all part of the information superhighway, like it or not. Electronic trinkets abound, and thousands more will follow. Who doesn't have a PC? Who doesn't have a fax machine? Who doesn't have a stereo system? And surely, who doesn't have a telephone?

In many parts of the country, cable TV servers and telephone companies are cooperating to replace copper wiring with fiber-optic cables to create interactive television and telephone services with fantastic bandwidth. These services will be more difficult to interfere with, because you can't create electromagnetic interference to an optical transmission system. But it might be many years before our homes are suitably cabled, and we'll still be using conductor-type appliances for the foreseeable future.

The solutions are amazingly simple. But many hams don't seem to want to know, or do, anything, to help themselves. If you're not a total dimwit, follow some simple advice: Interference problems can be resolved, and it's up to you to resolve them.

TVI

This is a relatively easy one. Television sets are intended to be receivers, they're just not particularly selective ones. If you and your neighbors are on "cable," and you're having TVI problems in your own home or those of your neighbors, the first order of business is to reduce the number of peripheral wires connected in the cable signal line. If you (or your neighbors) have appliances other than an approved cable TV converter box or a TV set connected, disconnect everything else (VCRs, preamps, switches, etc.) and see if the TVI persists.

The coaxial line from the cable service to the television set should be as direct as possible. Don't connect VCRs in this path! If you need to use a VCR, as most of us do, connect its input/output ports using audio cables to the television's audio input/video input and audio output/video output jacks. All the modern sets have such provisions. I see many licensed hams who have VCRs and other accessories connected to their cable lines, when it is completely unnecessary. Why convert audio and video signals to Channel 3 and feed them into the TV's tuner when you'll get far better results just plugging them directly into the audio and video amplifiers in the set, without using any RF? It doesn't make sense.

If you're on cable, do *not* use a preamp. They're a total waste of time for cable television services. The signal level from the cable should be sufficient to provide a good, strong signal to four, five, or six televisions without the need for any kind of preamplification. If you think you get "better reception" with a preamp in your cable line, either you're kidding yourself, or there's something seriously wrong with the signal level provided by your cable company. Ask them to come out and perform a measurement on your cable signal level. They all have small, hand-held devices which let them know immediately if your signal level is sufficient. If it isn't, then it is their responsibility to fix the problem, not yours.

Another warning if you're on cable: If your cable was installed more than a few years ago, it is very likely the service has deteriorated due to lack of adequate maintenance. The coaxial cables used need to be replaced every few years. They don't last forever. The connectors are not waterproof, and often fill up with water, creating a reduction in signal strength and the possibility of mixing signals with your transmitter, which in turn creates interference. Connectors should be clean and dry. You can check them yourself, if you can reach them. If you disconnect the cable from the "feed" (either above or underground), and water drips from the connector, this is a real problem that needs to be addressed. Water in an RF connector almost always indicates that water will also be present in the coaxial cable attached to it. This, too, adds attenuation and reduces signal levels. Normally, maintenance of the cable right up to the entry point of your home is your cable company's responsibility. The cable inside your home is normally your responsibility.

If you or your neighbors are not on cable, you may not have sufficient signal levels to override interference. Unless you can literally see the television transmitter's antenna from your TV antenna site, the signal will not be all that strong. Replace old, oxidized antennas with new ones, and make sure they are properly aimed. Avoid using 300-ohm "twin lead" for TV antennas! Use a 300-ohm-to-75-ohm balun instead, installed directly across the antenna terminals, and feed the antenna with high-quality, double-shielded RG59- or RG6-type CATV coaxial cable. (RG6 "quad," which has *four* shields and is "100% shielded" is an excellent choice. It's what the cable TV companies use, and it's not expensive.) If you don't have the proper crimping tool for type "F" TV connector installation, borrow or buy one. The best ones are not expensive, and are a good investment, since it seems these connectors are here to stay. If your TVI problems are from HF

(1.8-30 MHz) transmissions, try using a high-pass filter in the coaxial line to your television set, with the filter installed right at the rear panel connector of the TV, or better still, *inside* the TV between the rear panel and the tuner. Try grounding the case of this filter. If that doesn't help or makes the interference worse, remove the ground.

A word about high-pass TVI filters: These come in several "flavors," and performance is unrelated to cost in my experience. The most effective ones are really the 300-ohm "twin lead" filters, where each side of the balanced line is filtered. Unfortunately, the most effective TV transmission line is coaxial cable, not twin lead. Herein lies a dilemma, but it's an easily solved one. For stubborn cases of TVI, I've often found that using a coaxial feedline to the back of the set, followed by a 75-ohm (coax)-to-300-ohm (twin lead) balun, followed by a 300-ohm high-pass filter, followed by another 300-ohm (twin lead)-to-75-ohm (coax) balun, into the TV set's tuner, is what works best. Sure, it seems crazy to transform from coax to twin lead and then from twin lead back to coax again just to install a 300-ohm filter, but there is a method to this madness.

The problem with most 75-ohm coaxial cable high-pass filters is that while they do a splendid job rejecting interference conducted within the cable, they do absolutely zero for "common-mode" interference, which is carried on the outer conductor of the coaxial cable. Such interference conducts right past a 75-ohm coaxial filter, and enters the television set on the outer conductor (shield) of the cable alone, and can create nightmarish problems. By breaking up the cable's shield using isolation transformers and a balanced filter, such common-mode interference is thwarted by the "broken circuit" created. (P.S.—Good 75-ohm-to-300-ohm baluns, and 300-ohm high-pass filters, have almost no insertion loss, so don't worry about losing a lot of signal strength with this system. If you use good coaxial cable and a good 300-ohm filter, it won't happen.)

If the interference problems are from VHF-UHF transmissions, the best high-pass filter in the world won't help. You'll need to use a "stub," which is tuned to reject the specific frequency of the interfering signal. Such a "stub" will need to be one quarter-wavelength long, measured *in coax*, at the interfering frequency, and connected in parallel with the coaxial feedline to your TV set's tuner, as close to the tuner as possible. One quarter-wavelength *in coax* will be shorter than a real quarter-wavelength because the length needs to be corrected by the *velocity factor* of the coax used. For solid-polyethylene coaxial cable types, the velocity factor is usually 0.66; for "foam" dielectric coaxial cable types, the velocity factor is higher, typically 0.78 to 0.80 or so. Such a "stub" is easily connected to the backside of a television receiver using a "T" (or "tee") adapter having a single type F male fitting and two type F female receptacles. Such items can be picked up for a couple of dollars at Radio Shack or similar retail stores. By the way, in case you didn't know, a quarter-wave "stub" rejection filter has *no connection* to the "open end" of the coax. Don't short-circuit the open end, and don't terminate it with anything, or it will be completely ineffective. The quarter-wave "stub" works on the principle that the impedance of a transmission line is inversely proportional to its termination impedance every quarter-wave. If you leave a quarter-wave stub open-circuited at one end, the reflected impedance will be a short circuit at the opposite end, on the frequency where the stub represents a quarter-wavelength in coaxial cable. Thus, a quarter-wave "open-circuited" stub will look like a short circuit on its resonant frequency, and will shunt interference to ground. It works.

If you try hard enough, TVI is possible to eliminate. I've never seen a situation yet where I couldn't do it. It may take several hours, it may take a few dollars, but it can always be done.

Telephone Interference

This is a broad category that applies to all appliances connected to a telephone line: telephone instruments, computer modems, fax machines, etc.

Telephone interference is rare at VHF-UHF levels, but can be very troublesome at HF. One reason is that VHF-UHF signals are quite well shunted to common by the capacitance of the lines and instruments connected to them, but at HF this isn't the case. Another reason is that wavelengths are so much longer at HF that the near field interfering signals might be as far as a few hundred feet away on HF, while the near field is very short on VHF-UHF. Radiated signals are reduced in intensity by an inverse square law based on the wavelength being used. While 100 feet is very "close" on 80 meters, it is very "far away" on 2 meters.

Many telephone interference problems can be eliminated by terminating unused jacks. Since telephone lines are often "daisy-chained" (connected from jack to jack to jack within the house), any unused jack wiring becomes an antenna which can be an efficient receptor of signals. If you have telephone jacks in your home (or a neighbor's home) which are unterminated (no telephone instrument connected), these can cause problems. The easiest solution is to terminate them, whether a telephone instrument is used there or not, with correct passive terminations. Such terminations provide a 500-ohm terminating impedance (*not* a resistance alone!) across the line, simulating a real telephone-type instrument, and they are available for a couple of dollars from your local phone company or at Radio Shack.

If you've tried this and still have interference problems, try another trick: Go to the point of entry of the telephone line to the house and find the connection box located there. This is often a four-terminal "block" with brass machine screws, flat washers and nuts, where the telephone line from the utility connects to the house telephone wiring. Frequently, you will find unused wires just "floating" (not connected to anything) there. Any and all wires floating at this point (wires just twisted together and not connected to anything) can be grounded, since they're not being used, anyway. Strip the insulation off the unused wires, twist the exposed copper conductors together, and tie them to the nearest ground post, which is likely to be close by, since the telephone utilities usually provide an earth ground inside of or nearby this junction box. By grounding unused conductors in telephone wiring, you can short out some RF current which might be causing interference directly to ground. Also, since telephone wiring is often "twisted" along its route, grounding unused conductors tends to "shield" the entire bundle of wires, which can also help reduce RF interference.

If you try both of the measures outlined above and still have interference

problems, try using single-instrument telephone filters. These are sold by many manufacturers as "aftermarket" fixes, and usually have modular telephone plugs and jacks included. If telephone filters are used, they often work best when installed right at the telephone instrument (or computer modem, or FAX modem, or whatever), as close as possible to the equipment. Don't bother installing a telephone filter at the wall receptacle when a cord will be used between the wall socket and the instrument. It will be much more effective when used right at the telephone (or whatever). Sometimes a filter might be necessary in the handset cord as well. I've even seen situations where one filter did very little to reduce interference, but two or three filters in series at the same point worked perfectly. These filters usually retail for about $10 each and, if they work, are well worth the investment.

If you try all the tricks above and still have telephone interference, take a look at how your antenna transmission line is routed. Is it close to, or in parallel with, your (or your neighbor's) household telephone wiring? If so, move it! Is your HF antenna close to the telephone wiring from a street utility pole to your home? If so, move it! You are free to reroute telephone wiring as required to cure interference problems. You don't need the telephone company's permission. Just be sure that if you do reroute telephone wiring outdoors, use the telephone company's original cable, which is designed to withstand the abuses of mechanical stress and weather. Inside your home, these factors are unimportant and you can pretty much do whatever you want, since you own this wiring, anyway.

If in the process of investigating telephone interference you happen to find frayed, worn, or broken cables outdoors (between the telephone company's street wiring and your home), call the phone company and ask them to replace it. Beware of telephone lines. As benign as they look, they do carry a "ring" voltage capable of inducing quite a shock, and they need to be well insulated. Don't handle exposed conductors with bare hands. (This hazard only exists during a "ring," but you never know when that might occur.)

You might also try different telephone instruments. The complicated ones with electronic memory for telephone number storage and redial are sometimes more prone to interference than the old-fashioned "no frills" phones, purely because they contain additional electronic circuitry. The old Western Electric-built telephone instruments (remember the 1960s and 1970s?) which had a simple one-transistor tone oscillator, carbon microphone element and mechanical bell ringer were pretty "bulletproof" compared to most of the cheapie imports we use today. You can still find these simple but effective telephones, both new and used.

If worse comes to worst and you can't fix a telephone interference problem, try calling the phone company. Although their line filters are rarely effective, they do occasionally help, and they might find some unique problem in your local wiring or instruments. (But don't count on it: Since the divestiture of AT&T several years ago, I've found the local operating companies critically lacking in technical talent.)

"Grounding station equipment can also help prevent lightning damage in the event of a direct or secondary strike, but is by no means a "fail-safe" precaution."

If worse comes to really worst (like civil actions, threats with deadly weapons, etc.—don't underestimate the actions of a neighbor who can't use his telephone!), experiment with band and power changes. If you clobber your neighbor's phone when using 100W on 20 meters, try 10, 12, 15, 17, 30, 40, 80 meters instead. Or you might try reducing power to the minimum required to make contacts (which is a procedure we're all supposed to follow according to FCC Part 97, anyway). Although I'm an advocate of "Why use low power when a kilowatt will do the job?" thinking myself, experimenting with operating frequency and power level might reveal some useful data. You might find that the interference is frequency-specific, for which the obvious conclusion might be that the telephone wiring in question is resonant on some band you choose to operate. This is good to know, because telephone wiring can be altered in length without any notable change in performance, and simply adding or subtracting some length to your neighbor's telephone instrument wiring might shift the resonance out of the band you're trying to use.

Alternatives

Filters on your transmitters will be of absolutely zero help with telephone interference; however, a good low-pass filter on your HF transmitter *might* help reduce TVI ("might" is the key word here—don't count on it). If you're using modern-day equipment, with a high-quality coaxial transmission line connected to resonant antennas that are well matched, a low-pass filter may not help at all, but that doesn't mean you shouldn't try one. If you do try a low-pass filter on your HF transmitter, get one that is well-shielded and rated for considerably greater power output than you ever intend to use. Transmitting filters used on VHF-UHF transmitters almost never help reduce interference to appliances not intended to receive amateur radio signals.

If you're using an "end-fed wire" HF antenna, this is often asking for trouble. Although end-fed wires work just fine on any frequency where the wire length is not a half-wavelength, it usually means strong RF fields inside your own home, which can coincide with angry family members. There are some compelling reasons to use end-fed wire antennas (like no transmission line loss, regardless of VSWR), but if you have TVI/RFI/telephone interference, they are best avoided.

Experiment with grounding. Sometimes a good, low-impedance ground on your transmitter, or the interfered-with appliance, or both, can help. However, I've seen as many cases where a good ground makes no difference at all, and some cases where the grounding actually made interference worse. "Grounding" is not a magic cure. If you decide to try grounding, there are a few points to ponder:

1. The primary reason for a station ground is not to reduce interference. It is a safety precaution that can help save your life should other grounding systems (such as through your three-wire AC line cord) fail. Grounding station equipment can also help prevent lightning damage in the event of a direct or secondary strike, but is by no means a "fail-safe" precaution. At least one ham I know lost his home to a direct lightning

strike, even though his station was as well grounded as any I've seen.

2. There are differences between types of "grounds." A *DC* ground is any ground path that eventually leads to earth, no matter how long or resistive it may be. An *RF* ground is one offering low *impedance* (not necessarily resistance) to earth on a specific frequency or range of frequencies. It is almost impossible to achieve an RF ground at VHF-UHF since the path to earth would have to be just a few inches long at most. At HF, a true RF ground is achievable, but not easily. One example of a reasonably effective RF ground is the one that I use: a pair of 8'-long copper-clad steel ground rods driven into the earth directly below my operating bench (which is in the garage), connected to the station equipment using 2"-wide tinned copper braid capable of conducting more than 1,000 amperes of current. Such braid costs about $5 per foot retail, and isn't easily found. Also, not many folks can install ground rods directly below, and less than five feet from their station equipment. I did it by using costly masonry drill bits (1"-diameter) to drill through about one foot of solid concrete in my garage floor, then using a 16-pound sledge hammer to pound the ground rods in. This task took several hours to accomplish, since drilling through 12" of concrete isn't easy, and the ground was fairly hard. It also used up two masonry bits costing more than $30 each. And the work would have been impossible to do if the station had already been installed. (I did it prior to building the operating bench or installing any equipment.) Was it worth the expense and effort? Probably not. Do I really have an effective RF ground? Maybe. I wouldn't bet the farm on it.

If you have a second-story (or higher) ham shack, the likelihood of getting a real RF ground to your station is minimal. You're too far away from earth. However, this does not mean you cannot achieve a *tuned*, or frequency-specific, RF ground for a particular frequency of operation. One reasonably effective "counterpoise" (artificial ground, which works for RF but is neither a DC ground nor a hazard-preventing ground) is to use a quarter-wavelength "radial" of wire connected to the ground post of your equipment, with the free end connected to nothing at all! Trust me, it works. The MFJ product which effects an artificial ground and is tunable might also work in some cases.

Cable TV converter boxes also vary in workmanship and engineering quite a bit. Some are in plastic cases which are completely unshielded. Some are in metal enclosures which appear to be an effective shield, but really aren't. Most have only two-wire AC line cords which provide no grounding at all. In some cases I've seen, simply shielding the converter box using household aluminum foil has helped reduce TVI. These "boxes" are really cheaply made and designed to a price, rather than performance, specification. They should cost hundreds of dollars to perform their intended tasks, but in reality they sell for very little and barely work. Most have the insignia of an American company on them, but they're actually built offshore, in Taiwan or somewhere with even lower labor costs. There's nothing wrong with offshore manufacturing, except that these factories often cut corners on what were already cheap designs. If it has an AC power cord on it, the equipment is undoubtedly "UL Listed," which means absolutely nothing with regard to performance.

"Many consumer devices such as personal computers and modems are "FCC Class B" accepted, which similarly means nothing at all."

Check your antenna system, too. If it's an old installation, your connections could be oxidized or corroded, which can help generate higher levels of interference than a system built with shiny new components. Also check your coaxial cable. Brand-new, high-quality coax made by reputable manufacturers is usually pretty good; but lower-cost cables, surplus cables, or ones that have been in use for a few years or more may not be. Coaxial cables, especially when used outdoors, do deteriorate and require replacement.

While SWR is not a figure of merit for antenna performance, it can be an indicator of something being right or wrong. If you are using an antenna with a high SWR and "tuning" it in the shack to make it match better, there is still a mismatch between your feedline and your antenna, and there are still standing waves on your transmission line. Antenna mismatch will often cause transmission line radiation, which may tend to make interference problems worse. Adjust your antennas so they match your transmission line. This is not only more effective than using antenna tuners, transmatches, etc., it can also help reduce radiated interference.

You might also consider raising the elevation of your antenna, to get it farther away from the appliances you're interfering with. I had an interesting experience with TVI on 6 meters (50 MHz). This band is notorious for causing problems with TV Channel 2 reception, since 50 MHz is very close in frequency to TV Channel 2 to begin with. I was running 100W output power to a six-element beam up about 35 feet, and causing TVI to two or three neighbors. I tried several cures, none of which worked. In desperation, I finally tried raising my 6 meter antenna. I raised it to 45 feet, then to 55 feet, and finally to 60 feet, while testing for TVI. All these changes took some time, as I was adding tower sections!

Two weeks or so later, after adding the last tower section that raised the beam to 60 feet, I ran some TVI tests with the neighbors again. The interference had literally vanished! I raised my transmitter power. Eventually, I had 1200W output power on 6 meters (from a pair of 3-500Z's) and literally zero TVI. Previously, I had severe TVI with the same transmitting equipment (and much lower power) and the same beam antenna, but the beam was up only 35 feet. The difference was that when the beam was up 35 feet, it was only slightly above my neighbors' rooftops, and nearly in line with their TV antennas. By raising the antenna another 25 feet I was well above their homes and their antennas, thus considerably reducing the strength of my radiated signal to their TV antennas, even when operating at far greater output power.

Agency Approvals

They mean absolutely nothing. Really. Many consumer electronic and electrical appliances are "UL Listed," "UL recognized," "FCC Class B approved," and so forth. It doesn't mean a thing. U.L.

(Underwriters Laboratories) and C.S.A. (Canadian Standards Association), as well as many foreign agency approvals (T.U.V., V.D.E., etc., ad nauseam) don't mean anything in the real world. Many consumer devices such as personal computers and modems are "FCC Class B" accepted, which similarly means nothing at all. While PCs and peripherals are all "Class B approved," they radiate RF energy like mad, and can similarly receive RF energy that can render them useless in strong RF fields.

U.L. and other agency approvals have nothing to do with performance. U.L. employs almost no real engineers, and has literally zero experience in RF interference or other real-world situations. They "list" or "recognize" equipment based on safety criteria (meaning, the equipment probably won't catch fire when operated according to instructions), irrespective of any performance ratings or criteria. I've dealt with them quite a bit over the past 25 years or so and am extremely unimpressed with their knowledge of electronic circuits. To wit, I asked four different U.L. "engineers" how they determine if electronic equipment is safe for use. Without referring to manuals, not a single one could answer my question. After referring to manuals, none gave a satisfactory answer that even peripherally indicated they had any experience with electronic circuits. If these folks are the "experts," we're in serious trouble.

> ***"This can open a Pandora's Box of problems that will haunt you forever."***

When All Else Fails

Ask your neighbors to contact the FCC. Don't be afraid! The FCC isn't out to "get" you. If you're a licensed amateur radio operator and are using your equipment within its ratings and limits (and the limits of your license class), you're probably in good shape. The FCC recognizes that amateurs are licensed to transmit, and your neighbors are not licensed to receive. Reception of television and radio signals is a privilege, not a guarantee. Even telephone calls unencumbered by interference are not guaranteed by the FCC. Indeed, your local telephone utility company guarantees its users some degree of communications which should not be encumbered by radio interference, and if its users find telephone services to be worthless, they really don't have to pay their telephone bills until the problem is corrected.

Utilities are regulated by the Public Utilities Commission, which guarantees users some degree of service in return for fees paid. Communications services are further regulated by the Federal Communications Commission, which recognizes the weaknesses of many user appliances and are usually empathetic with amateur radio operators. It is a ham's responsibility to try his (or her) best to resolve interference problems prior to requesting FCC intervention. But when all else fails, you'll be surprised to find that the FCC is not an enemy, but rather an advocate. I've dealt with the FCC on interference problems more than once, and they've never asked me to stop transmitting yet.

Summary

Interference problems can all be resolved. It takes mutual cooperation on the part of the amateur and the complainant. If the complainant won't let you help him or her, you won't get very far in negotiating with them.

Don't try to "fix" your neighbor's television, radio, telephone, computer or whatever. This can open a Pandora's Box of problems that will haunt you forever. I once voluntarily installed a high-pass filter inside a neighbor's TV set (more than 20 years ago), which did help resolve an interference issue. Two years later, that neighbor tried to sue me for ruining her television, when her picture tube failed and required replacement. (Trust me, I never touched her picture tube.) It's better to recommend filters and so forth, and recommend they be professionally installed or installed by the user. It's even a nice gesture to offer to pay for such filters. I've done it, and I'd do it again, if it makes my neighbors happy.

For a short while I lived in a townhouse community where I had neighbors quite close by. I didn't get into their televisions, but I did cause quite a problem with their telephones. As a neighborly gesture, I offered to buy them all telephone filters. The filters worked great, but it cost me more than $200 to buy all the filters required. This sounds like a lot of money, but I don't regret the decision. It quelled a real problem and allowed me to operate the HF bands without having neighbors complain about it! (One case of telephone interference was so severe, no amount of filtering seemed to help. I offered that neighbor free use of my portable cellular telephone, which had no interference at all, when he needed to call someone and I was on the air. The bills amounted to maybe $10 or $15 a month, but the neighbor was satisfied, I was working DX, and the world was a nice place.)

If you still have problems, write or call me and I'll try to help you out. If you don't, then this article served its purpose. 73 and good DX!

Number 50 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
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Niles IL 60714-3108

Since we began this column three issues ago, a number of worthwhile ideas have been received and they continue to arrive daily. Many thanks to all who've contributed their time and effort to make this a success, and I'm hopeful that the response seen so far will grow even more enthusiastic in the future...remember, this should be your column, with your ideas and suggestions.

Here's a basic rundown of what I'm looking for in the way of reader input. Everyone has different experiences in amateur radio, with different equipment and varying setups; each of us has encountered any number of instances where we've made improvements, both major and minor, to what the equipment manufacturers "think" that we want. Some of the modifications are primarily operational in their nature, others make the equipment more technically sound. I'd like to hear about your innovations, with the possibility of passing them on to all of the others reading this column. That's what "Ham To Ham" means, one ham's helpful hits, ideas or suggestions to another who might be in a similar situation or have similar needs. Hams have always enjoyed helping one another, that's part of the fun of the hobby, and this column is a way of extending that helpfulness to many, many others all at once.

Not everyone wants to write a complete, long, drawn-out article on an innovative idea that they may have come up with, so here's your chance to jot down the basic details, in casual form, and I'll put the finishing touches on it, if need be, for the column. Don't worry about your writing style, just try to be as complete as you possibly can, but even if you're not sure, send it to me and I'll let you know if I feel that more information is needed. I'm primarily interested in down-to-earth, practical ideas that others can duplicate with relative ease. Here's an example of a simple idea, something that's easily duplicable by most hams, yet many may have been reluctant to apply it to their own situation.

Pilot Lamps and Today's Radios

Have you noticed how difficult it's become to change a burned-out pilot lamp in most of today's modern transceivers? In the "good old days"—when radios and pilot lamps were both a lot bigger—changing a dead lamp was a pretty straightforward, easily accomplished job. Lamps were usually mounted in sockets, and normally just a twist of the wrist popped the lamp right out, ready to install a new one. Not so anymore! Most lamps are now on tiny wires, soldered in place and often buried deep within the radio's front panel wiring. It's become such a problem that many hams don't bother changing the lamps when they do burn out, or they wait until something else much bigger in the set needs attention, changing the pilot lamp then as something of an aside to the larger problem.

What follows may not make the task of lamp replacement any easier, but it might just double or triple the time between pilot lamp failures, and it's not usually too difficult to accomplish.

Here's the first tip: When a pilot lamp does burn out, most hams probably think in terms of going to the radio's manufacturer for a "direct replacement," but often that's the most expensive and time-consuming route to take. Here's an alternate approach that's ordinarily much, much easier. Radio Shack stores stock a number of small, low-voltage lamps, most of which work on what your transceiver supplies as pilot lamp voltage—usually 12 volts DC. By the way, using a replacement lamp rated at a higher voltage is fine, just as long as it will provide enough brightness once it's in place. In fact, a higher voltage lamp will last quite a bit longer than one that's rated right at the nominal supply voltage. That leads us into the rest of the story. How do you extend the life of those tough-to-get-at little pilot lamps?

If you lower the supply voltage to any incandescent lamp, you'll increase the lamp's life dramatically. Tests have shown that the life expectancy of an incandescent lamp zooms upward as the voltage across it goes down, and of course, vice versa. Lowering the voltage across a 12-volt lamp by just a couple of volts, for instance, will extend the lamp's expected life by two or three times! Just a series resistor in the lamp's supply lead will do it for you, but there are some other considerations. You'll have to determine how much light loss is acceptable in your particular operating configuration, because there will be loss of brightness if the voltage to the lamp is reduced. Once you have determined how much illumination you can afford to lose, you'll need to know the value of the resistor needed to drop the voltage just enough to accomplish that objective. Finally, the power to be dissipated by the resistor will determine what wattage resistor is needed.

Lowering the voltage across an incandescent lamp will definitely reduce its light output and it will also shift its color somewhat toward the red region. The more the voltage is lowered, the more red-shift occurs.

I have a couple of flood lamps illuminating the front of my house each night that are wired in series, i.e., the lamps run at 1/2 voltage across each lamp. They're very much on the "warm side"—red-shifted—but have been going for years and years each night without burning out, because voltage-rating-wise, they're loafing along!

Getting back to our pilot lamp discussion, you can easily determine what resistor to use in series with each lamp by using Ohm's Law: Voltage drop desired (V) divided by the lamp's rated current (I) equals the correct resistor (R) needed and Voltage drop (V) desired times the lamp's rated current (I) equals the resistor's wattage (P).

By way of example, let's take the Radio Shack #272-1141 lamps mentioned earlier, which have a current rating of 25 milliamps—or 0.025 amp—and assume that we would like to drop the 12-volt lamp supply by 2.5 volts—down to 9.5 volts. Plugging in these values we get: 2.5 volts ÷ 0.025 amp = 100 ohms and 2.5 volts times 0.025 amp equals 0.06 watt.

Now we know that we'll need a 100-ohm resistor in series with each lamp, and that a 1/2-watt dissipation rating on each resistor will give us a good margin of safety.

Another way to lower the voltage to all of the lamps in the set at one time would be to use a 3-terminal adjustable voltage regulator supplying something less than 12 volts to the lamp supply bus, but in most cases, that's something of an overkill. You would also have to be sure that nothing else is tapped off of the lamp supply bus that might be adversely effected by a slight voltage reduction. The individual resistor in series with each lamp is usually the safest approach unless you know the transceiver's circuitry well.

Remember, the more you can lower a lamp's voltage from its nominal rating, and still have enough light output from it, the longer that new pilot lamp will last once it's in service.

Reducing Scratches

Sometimes accidents happen, and a plastic meter face, dial cover or even a wristwatch faceplate can become marred with an ugly scratch or dig, often making it difficult to even read through the scratch mark.

Next time that happens to you, try using a small amount of metal polish, such as Brasso™, to polish out the imperfection...it really works. Most of these products are composed of a very fine abrasive that, if used properly, will eliminate or minimize many scratches—even relatively deep ones—restoring the damaged piece to usable condition again.

Try folding a paper napkin, and with the tip of your finger

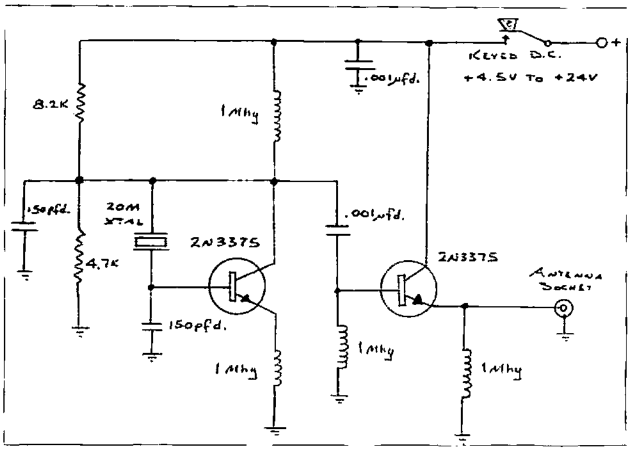

Fig. 1. 4X1UF's ultra-compact 20 meter CW QRP transmitter schematic diagram. See text for further details.

backing it up, apply a small amount of polish to the damaged surface. Take your time, applying only the amount of pressure needed to remove enough of the surface plastic to polish out the scratches in question. You might want to try this on a couple of scrap plastic pieces first, just to get a "feel" for the procedure. Rub over the scratch several times and then wipe the dried polish completely off. If the surface has "fogged" a bit, repeat the procedure, but this time using progressively lighter pressure.

For very light scratches, even ordinary typing paper may be just abrasive enough to polish the surface sufficiently. Try using the paper just as is—without any additional external abrasive applied to it.

Most reasonably sized marks—and even some pretty big ones—can be removed or greatly reduced in this manner. It even works on scratched CD-ROM disks, but again, better to practice on a "throw-away" one first.

Submitted by: Herb Foster AD4UA, 3020 Pennsylvania Street, Melbourne, FL 32904-9063

Moderator's Note: most cleansers and polishes will exhibit the abrasive effect that Herb refers to above, so you might want to try a number of them—keeping notes on which work best for you—on several samples of scrap plastic. You might also want to try a mild-abrasive automobile rubbing compound or an optical lens grinding compound as well. Jeweler's rouge, a very fine abrasive in an oil-based cake form, is also very useful in the same manner—you might check with a jeweler's supply house or your own neighborhood jeweler to see about obtaining a small container for the next time you need it. Jeweler's rouge is also excellent for cleaning tarnished connector contacts and intermittent battery connector springs, as well as your XYL's gold rings and bracelets! Brasso, mentioned above, is a registered trademark of Reckitt & Coleman of Wayne, NJ.

Two-Stage QRP Transmitter

All the way from Israel, Lavee 4X1UF contributed this interesting little two-stage, 5-watt, 20-meter CW QRP transmitter circuit for experimental purposes.

In the circuit diagram of the Fig. 2, the first 2N3375 transistor is wired as a Pierce Oscillator, and is capacitively coupled to a second 2N3375 that functions as a buffer as well as an impedance converter. Lavee writes, "...by drawing as much current as needed by the stage," the second 2N3375 "...acts as an automatic antenna tuner. The lower the impedance, the higher the current" drawn from this stage. The need for an external antenna tuner is therefore minimized, except perhaps as a tuned circuit for harmonic reduction, since no tuned circuits are employed within the two-stage transmitter itself. These days, some sort of harmonic reduction would be well advised.

"The need for an external antenna tuner is minimized, except perhaps as a tuned circuit for harmonic reduction."

Lavee built his unit into a very small copper box, bolting the 2N3375s directly to the box and bringing the RF out via an RCA-type "phono" jack. Direct point-to-point wiring is used, with all grounds soldered right to the copper box itself with the shortest possible leads. With 24 volts keyed DC applied, he was able to realize about 5 watts of RF output on 20 meters. He further cautions that the box can get very warm after a time, so either additional heat-sinking might be required, or key-down time kept to an absolute minimum—lower V_{cc} input voltage would also reduce heat, along with the output power. A small 12-VDC fan might be a worthwhile addition if the heat dissipation is still too great. Lavee commented that after final testing, he covered all of the internal components with a heat-dissipating epoxy for additional component mechanical stability as well as better heat transfer.

From 4X-land, this is an interesting circuit with lots of potential for QRP enthusiasts. Questions and comments should be directed to: Lavee Israel 4X1UF, c/o International Electronics Services, 12/21 Got Levin St., Haifa 32922, Israel.

That's our "Ham To Ham" column for this month. Please keep your ideas, tips, suggestions and shortcuts coming and we'll use as many of them as possible in each of the coming months. Please send them to the address at the top of this column, not to *73 Magazine* directly.

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73 Magazine*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73 Magazine* for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73 Magazine's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73 Magazine*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator, nor to *73 Magazine*.

73, de Dave NZ9E.

HOMING IN

Radio Direction Finding

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More About Hamcon/ Foxhunt-95

"We need more young people in ham radio!" Wayne says it. I've said it, and you have probably said it, too. What if I told you that there is a way for kids of almost any age to learn about radio without realizing they are being educated, while they have so much fun they won't want to stop? They'll also be getting lots of fresh air and exercise, far more than they would get sitting in front of a computer screen. Best of all, the kids don't need to be licensed; they can start immediately.

Yes, such an activity exists. In some eastern European and Asian countries, it is so popular that it's part of Physical Education in schools. The sad fact is that it's rarely done stateside. Hams in our education industry haven't discovered it yet. This best-kept secret is a sport called "foxhunting."

Hide-and-Seek With Radios

Unlike more familiar mobile "T-hunts," an international-rules foxhunt is an on-foot search for several concealed mini-transmitters in a large outdoor setting. Kids love it, and so do adults. I explained the concept in detail in last month's "Homing In." I also began the story of Hamcon/Foxhunt-95, Southern California's first international-style radio direction finding (RDF) championship. It was held September 3 on the Fort MacArthur Military Museum grounds in the San Pedro area of Los Angeles. I served on the committee of Southern California Six Meter Club members who put on this 2 meter event for the 1995 ARRL Southwestern Division convention.

Photo A. Fox #3 was next to the long staircase on the edge of Batteries John Barlow and Saxton, an abandoned WWI shore defense site at Fort MacArthur. One hunter hasn't realized yet that he is standing on top of it.

Hamcon/Foxhunt-95 simulated as closely as practical a European/Asian foxhunt. Our rules were based on International Amateur Radio Union (IARU) rules for direction-finding championships. Unlike IARU events, there was no separate division for women and competitors in all divisions were required to search for all foxes. Age divisions were different from IARU classifications.

International-style foxhunting is new to Southern California, but that doesn't mean all Hamcon/Foxhunt-95 participants were complete greenhorns. Many of the forty who signed up were experienced mobile T-hunters who had learned techniques for "sniffing" out transmitters on foot, whereas others had never tried RDF before. How could we put on a hunt that challenged the experienced T-hunters but gave first-timers a chance to do well?

The fox-hiding subcommittee decided to put out six foxes. Two transmitters would be easy to find, two would be really tough, and two would be in-between. Foxes #6 and #2 were intended to be the easy ones. We hid #6 under the concrete cover of an abandoned 40-year-old underground command post for Nike defense missiles on a hilltop 900 feet southeast of the start point. The antenna for Fox #2 was N6MI's horizontal dipole in a tree 400 feet west of the finish line. Both of these foxes were high and in the clear, relatively speaking, so hunters should have gotten sharp bearings.

IARU rules require red and white flags (called prisms) next to each fox. They are appropriate in the deep-cover forests where world championships are held, but they would have been far too conspicuous in the fort areas. So we did not use them. The bright orange punches within five feet of each transmitter were easy to spot and provided sufficient visual identification.

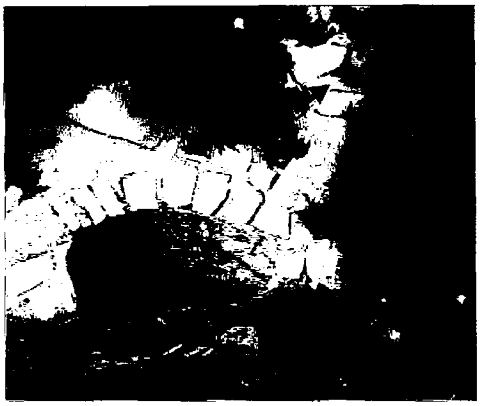

Photo B. The most dastardly fox hiding spot was deep inside this drainage channel, 200 feet from the beach. The orange card-marking punch is just barely visible in the wall-climbing plants.

Fox #3 was supposed to be very hard. It was on the steep slope of a 50-foot-deep football-field-sized pit that used to be part of a World War I mortar emplacement (Photo A). Its antenna was a twin-lead J, most of which was buried a couple of inches into the dirt next to the long stairs. The idea was to "light up" the entire pit with lots of RF and create many signal reflections. The ultimate challenge was Fox #4, which was underground, five feet into a sea-level drainage channel near the southern end of the park (Photo B). All foxes except #4 were at least 50 feet from the nearest trail.

The shortest possible route reached the foxes in the following order: #3, #5, #6, #1, #4, #2. Hunters traveling that route directly would have gone 1.35 miles. This is about one half of the shortest route in a typical IARU championship foxhunt. Of course, nobody's route was close to being that short. Overall winner Scot Barth KA6UDZ found all foxes in 66 minutes and Senior Division (over age 46) winner Marvin Johnston KE6HTS did it in 76 minutes (Photo C). By comparison, a Hungarian and a Russian completed a much longer five-fox 2 meter course in just 47 minutes at the 1994 World Championships in Sweden.

According to the fox-hiding corollary to Murphy's Law, "Everyone will easily find the foxes that you think will be hard, and vice versa." The pit didn't create a pool-table effect for Fox #3 signals. Eighteen hunters found it. On the other hand, the high horizontal dipole of Fox #2 must have caused some unusual signal reflections, because many hunters reported that bearings to it crossed on top of a hill 400 feet northeast of it. The fox found by the most hunters (28) was #5; the one found by the fewest hunters (8) was #1. Both had been expected to be medium difficulty foxes.

This foxhunt was the last event of the convention, on Sunday afternoon. All day Saturday, a half dozen or so "micro-Ts" transmitted for a few seconds each from hiding spots around the Queen Mary convention site, including the hotel, exhibit area, and parking lot. This gave everyone a chance to check out RDF gear and practice techniques.

A few eager entrants didn't wait until Saturday to get ready. Rick Barrett KE6DKF, who

Photo C. Marvin Johnson KE6HTS picked this high spot overlooking the ocean to take a bearing. He took first place in the Senior Division.

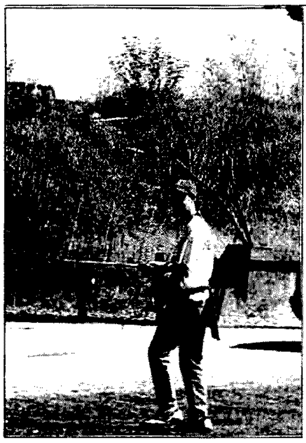

Photo D. Tom Mirabella KD6AAN, age 14, took first place in the Youth Division. He found more foxes than his dad, Ken KM6YH.

placed third in the Prime Division (ages 18 through 30), was glad he had practiced diligently. "Scott Barth KA6UDZ, another hunter, and I went up to Glendora to a local sports park several times," he told me. "We would each hide a fox in the park and then we'd hunt each other's foxes down. Once we found all of them, we'd move them and find them again. We did it after dark so we would not see each other hide them. This allowed us to get used to our equipment, so we could trust it and not just what we saw."

Everyone Is Able

Fox hunters who win international championships are true athletes who train just like world-class competitors in any other running sport. By contrast, Hamcon/Foxhunt-95 entrants were a cross section of ordinary hams, ranging in age from 11 to 70 (Photo D). The median age was 38. There were no cross-country runners, and two could not run at all. The story of these two is proof that foxhunting is a sport for almost everyone.

Photo E. Mike Obermeier KD6SNE "sniffs" in his wheelchair and T-hunts regularly on 2 meters in a converted mail delivery truck with a 4-element quad and a Roanoke Doppler. The photo isn't backwards; the steering wheel really is on the right side.

Mike Obermeier KD6SNE is a regular at Southern California mobile T-hunts. Because of a spinal cord injury, Mike has adapted his T-hunt vehicle to include hand controls for the accelerator and brakes (Photo E). In just a few seconds, he can maneuver himself out of the truck and into his sports wheelchair for sniffing out the T.

When I promoted this foxhunt at a mobile T-hunt in August, Mike told me he really wanted to compete. He kept asking, "Can I do it in my chair?" I knew the site had plenty of paved and unpaved trails, but there would be no way to place all the foxes so he could roll right to them. There are no provisions in the IARU foxhunt rules for this sort of situation. Mike didn't want a special course just for him, nor did he want the course made easier on his account. All he needed was a way to finish closing in after he had done the basic RDF work on wheels.

Fortunately, I had an expert nearby for consultation. My wife April WA6OPS is a Registered Occupational Therapist and former rehabilitation department head at a major medical center in Orange County. Occupational Therapists are trained to find creative ways for persons with disabilities to adapt to their physical limitations and

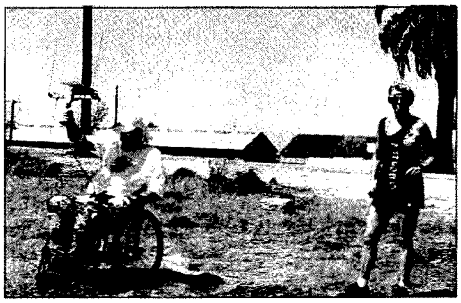

Photo F. KD6SNE cruised the foxhunt course in his wheelchair. Christie Holoubek KØIU, his Extender, went into the brush on his command to uncover foxes and punch his competitor card.

***Photo G.** On the downhill, KØIU had to move fast to keep up with KD6SNE.*

return to regular activities of their daily living.

April suggested that Mike be provided with an assistant on the foxhunt course to perform search duties in areas of the park that were inaccessible to his wheelchair. I countered that the competition was for individuals only, not two-person teams, and that other contestants might consider it unfair to go up against the team of Mike and an assistant. After some discussion, we agreed that the assistant would be selected by the hunt committee and would be allowed to act only as an extension of Mike's range. Mike would do all the RDF work and maneuver his chair as close as possible to the foxes. Then Mike's Extender would go into any inaccessible places and search, without equipment, at his direction (Photo F).

Mike thought this idea was great and quickly agreed to the terms and conditions. Christie Holoubek KØIU agreed to act as his Extender. There was no concern about Christie being able to keep up with Mike, because she is an accomplished marathon runner (Photo G).

One week before Hamcon/Foxhunt-95, I received e-mail from Marvin Johnston KE6HTS of Santa Barbara. He and Dennis Schwendtner WB6OBB were coming to the hunt and he wanted to know if Dennis could participate on a team. I already knew that WB6OBB's keen hearing had made him a successful "navigator" on mobile T-hunts in Santa Barbara for many years, despite the fact that he is sightless. I told Marvin that there would not be a team competition, but we would try to find another good Extender so that Dennis could hunt.

WB6OBB liked the idea, so April asked an acquaintance who had expressed interest in amateur radio to be his Extender. April's instructions were that she could act only as eyes for Dennis, and could not do any RDF for him. Besides insuring his safety, she was allowed to describe to Dennis the terrain features and the presence of other hunters in the area in which they were searching (Photo H).

No one at the foxhunt starting line was more excited than Mike and Dennis. Of course, not all sporting events turn out like a Rocky or Mighty Ducks movie. Neither Mike nor Dennis won a medal. However, both received certificates for successfully finding foxes, and their extenders got a real workout. I'm sure all four are hoping that organizers here and abroad will improve the rules so all future international-rules foxhunts are as accessible to handicapped hams as this one was.

As you can see from the photos, Hamcon hunters used a wide variety of RDF gear, from the commercial sets used by KE6HTS and KD6SNE to KD6AAN's yagi and the foil-tube attenuator of WB6OBB. Every hunter has personal preferences for equipment. Selecting just the right sniffing setup for your needs will be the topic of an upcoming "Homing In" column. Meanwhile, keep me informed about both mobile T-hunting and on-foot foxhunting in your area. Write to the address at the beginning of this article or send e-mail to me via Internet (Homingin@aol.com) or CompuServe (75236,2165). 73

***Photo H.** Long-time T-hunter Dennis Schwendtner WB6OBB didn't let his blindness keep him from having fun at Hamcon/Foxhunt-95. Future ham Linda Reagan served as his Extender.*

HAMSATS

Amateur Radio Via Satellites

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The AMSAT Annual Meeting

The 1995 AMSAT Annual Meeting and Space Symposium was held October 6-8 in Orlando, Florida. Over 200 satellite enthusiasts listened to dozens of presentations and visited the Phase 3D integration facility. For all participants it was a fantastic weekend. STS-73 was scheduled for launch during the weekend only 40 miles away at the Cape, but due to weather and other delays, it was a hamsat weekend and not a hamsat/shuttle weekend.

Photo A. Phase 3D Satellite Project Leader, Dr. Karl Meinzer DJ4ZC, addresses the 1995 AMSAT Space Symposium in Orlando, Florida.

Friday

This year the presentations began Friday before noon with a paper by Bob Bruninga WB4APR about a new software program called APRtrack. Gwyn Reedy W1BEL of PacComm described the capabilities of the program and its use for determining the locations of ground stations and spacecraft using packet radio and GPS (Global Positioning System) data. Shareware versions can be found on various BBSs, while registered copies can be purchased from WB4APR or AMSAT. AMSAT VP for Manned Space Activities Frank Bauer KA3HDO, John Nickel WD5EEV, and Matt Bordelon KC5BTL updated the group on the progress of SAREX, the Shuttle Amateur Radio EXperiment. SAREX did very well in 1995 with random QSOs and many fine scheduled contacts with schools from the ham-astronauts.

Ignacio Martinez CE2MH of AMSAT-CE (Chile) described the Fodtrak tracking and tuning software. The program was developed in Chile to help fund the satellite CESAR-1.

Other afternoon talks included methods of developing and utilizing satellite gateway nodes by Barry Baines WD4ASW, development of microsat ground station software for Linux and X-Windows by John Melton GØORX/N6LYT, ways to extend the lifetime of scientific satellites by Philip Chien KC4YER, and details on the success of the joint AMSAT/TAPR (Tucson Amateur Packet Radio) DSP-93 project. The Texas DSP-93 crew included TAPR President Greg Jones WD5IVD, Bob Diersing N5AHD, Bob Stricklin N5BRG, and Frank Perkins WB5IPM.

Finishing the afternoon activities was Phil Karn KA9Q with a demonstration of digital voice via the World Wide Web on the Internet.

A brief dinner break followed. Evening presentations began with a slide show on satellite DX by Mikio Mouri JA3GEP.

Doug Howard KG5OA followed with the latest exploits of balloon enthusiasts in Texas. He described the many payloads in previous and current packages that the groups send to the edge of space.

David Liberman XE1TU showed a video of the attempted launch of UNAMSAT-1 on a converted Russian ICBM. The launch failed, but UNAMSAT-2 is nearly complete, waiting for a chance to become an OSCAR (Orbiting Satellite Carrying Amateur Radio).

Dan Schultz N8FGV delighted the audience with his pictures from the Hubble Space Telescope. Dan showed several new and exciting images from the telescope taken after the Shuttle repair mission. He had a few picture copies which were included as handouts for those attending.

Bruce Paige KK5DO finished the Friday talks with his description of the efforts in Houston to get the local Houston Area AMSAT Net out to as many hamsat enthusiasts as possible via commercial geostationary satellite link and HF. The Houston net can be heard every Sunday night at 10 p.m. Central time on Telstar 302, Transponder 21, 5.8 MHz audio subcarrier or on 1860 kHz am from Missouri. Many VHF and UHF repeaters in North America also carry the net via the satellite feed.

Photo B. AMSAT VP of Engineering, Dick Jansson WD4FAB, coordinated the Phase 3D talks at the AMSAT Symposium.

Saturday

Activities began in earnest at 8 a.m. AMSAT President Bill Tynan W3XO gave an official welcome to the symposium participants.

With the scheduled launch of Phase 3D only a year away, the focus of the symposium was on the new satellite. AMSAT VP of Engineering Dick Jansson WD4FAB moderated the morning talks, all dealing with progress of the Phase 3D program.

Project Leader Dr. Karl Meinzer DJ4ZC brought participants up to date on launch opportunities, financial considerations and an overall picture of the program. The planned launch is to occur late in 1996 on the second flight of an Ariane 5 vehicle. If there are difficulties with the schedule, the satellite may be launched as late as mid-1997 on an Ariane 4 rocket. Phase 3D is on schedule, but still needs more money to pay for launch costs and the many other items that come with any launch campaign.

Most of the mechanical efforts for Phase 3D are the responsibility of AMSAT-NA (North America). Dick WD4FAB presented details on the structural and thermal design, while Stan Wood WA4NFY followed with antenna location and other considerations. It has been quite a challenge to orient the spacecraft antennas on one face of the satellite without causing interaction problems.

AMSAT Board of Directors member Dick Daniels W4PUJ related information on the propulsion system. The satellite has a kick motor similar to the previous Phase 3 satellites, but it also has an ammonia arc-jet motor that will be used for many months during final "tuning" of the orbit. The plumbing for the motors is in place and waiting for final wiring.

Lyle Johnson WA7GXD and Chuck Green NØADI

Photo C. Stan Wood WA4NFY and his cake-pan, 1.2 GHz backfire antenna.

Photo D. AMSAT Board member and past President, Dr. Tom Clark W3IWI, shows one of the L-band "salad bowl" antennas for Phase 3D.

characterized various Phase 3D computer systems. The main operations computer is called the IHU or Internal Housekeeping Unit. Other computers include the GPS system and the RUDAK digital communications controller.

Peter Guelzow DB2OS covered the Controller Area Network or CAN that will be used for digital communication between subsystems onboard Phase 3D.

AMSAT President Emeritus Dr. Tom Clark W3IW1 described his Global Positioning System (GPS) experiment for Phase 3D. Bdale Garbee N3EUA and his crew have been working on the GPS computer subsystems and writing software for use in the spacecraft. Bdale passed several prototype boards around the audience during his talk.

Hiroyuki Ohata JM3MAJ brought a prototype of the SCOPE digital color imaging experiment with him from Japan. His presentation provided details on the specifications of the two-camera unit. The

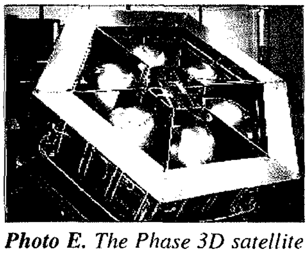

***Photo E.** The Phase 3D satellite is progressing well at the AMSAT lab in Orlando, Florida.*

***Photo F.** Integration Laboratory Manager Lou McFadin W5DID in the clean room with Phase 3D shows the location of one of the 12 magnetorquer rods to be installed.*

equipment will be located in the spacecraft with holes strategically located to allow the cameras, one wide angle and the other narrow, to view the earth at the orbit's high point or apogee.

AMSAT Integration Laboratory Manager Lou McFadin W5DID wrapped up the morning talks with data on the complex wiring harness for Phase 3D and methods now used in the lab to keep up with all the parts to be built into the 1,000-pound satellite. Lou joined the project after retiring from NASA at the Johnson Space Center in Houston.

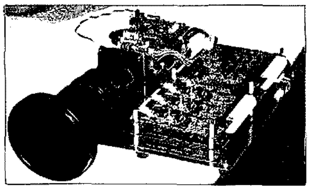

***Photo G.** A prototype of the Japanese SCOPE Digital Color Imaging Experiment camera was on display at the symposium.*

Afternoon sessions concentrated on future satellite programs. Peter Vekinis KC1QF/EI4GV got things started with ideas about very small satellites, or picosats. Measuring only five inches on a side and incorporating active three-axis stabilization, Peter proposed a constellation of picosats in low earth orbit, all using VHF and UHF frequencies. While still in the early planning stages, the program is thought provoking and may provide future satellite builders with ideas.

Steve Bible N7HPR discussed his efforts with the World Wide Web Amateur Satellite Ground Station. For those with Internet access, the address is http://gndstn.sp.nps.navy.mil

The system Steve created maintains data received from the 9,600-baud amateur satellite (UoSAT-Oscar-22, Kitsat-Oscar 23 and Kitsat-Oscar-25). Steve also gave an update on the PANSAT project sponsored by the Naval Postgraduate School in Monterey, California. Using spread-spectrum techniques, this small satellite is scheduled for launch in 1997 and will use the frequency range from 435 to 438 MHz for both uplink and downlink. Work has begun with TAPR to provide earth-station hardware and software to communicate with the satellite. Updates on the PANSAT project can be found via the Internet at http://www.sp.nps.navy.mil

SEDSAT Project Manager Dennis Wingo KD4ETA brought everyone up to date on the status of the SEDSAT program. SEDSAT-1 is a microsat-class satellite that will be part of NASA's Small Expendable Deployer System (SEDS). Changes in launch schedules have caused delays with this hamsat. SEDSAT will carry several scientific and amateur-radio experiments. The main purpose of the satellite is to test the dynamics of tethered satellites and remote sensing. The SEDSAT program also has a World Wide Web home page at http://seds.lpl.arizona.edu

Ken Emandes N2WWD completed the afternoon talks with an enlightening description of his efforts to properly identify the Russian RS-15 satellite and its orbit. Orbital data from NORAD and NASA

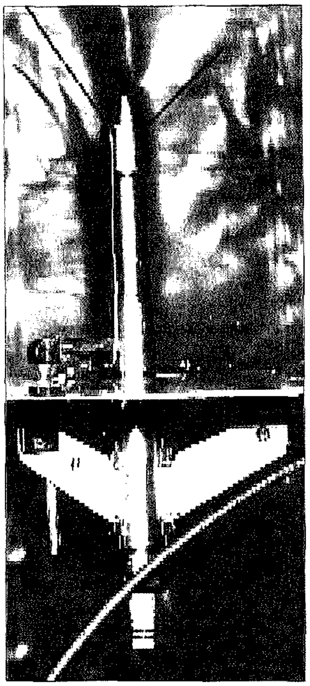

***Photo H.** The ammonia arc-jet motor will be on for several months after launch to fine-tune the orbit of Phase 3D.*

was inaccurate in the early days following the launch of the satellite. Ken determined that the upper-stage vehicle had exploded leaving many radar targets in the area of the satellite. Determining which space objects were nothing but debris, and which was RS-15 became a challenge. While NORAD used their sophisticated radar systems to catalog the objects, Ken used both the NORAD/NASA data in conjunction with the 10 meter ham-radio signals transmitted by RS-15 to characterize the orbit and identify the satellite.

After Ken's talk, AMSAT President Bill Tynan introduced the officers and Board of Directors' members. Each officer or director was given a chance to speak to the group. It was also a time for questions and answers from the attending AMSAT members.

Following a short break to allow everyone to catch their breath and relax after data input overload, the yearly banquet began. The speaker was Dr. Paul Shuch N6TX. Last year he talked about "The

Search for Dark Matter." This time he provided details about the SETI League. Paul is now the Executive Director of the organization and provided everyone with an informative, yet light, discussion on the search for extra-terrestrial intelligence. He has that unique ability to make the most complex topic both understandable and fun.

Bill Burden WB1BRE of the American Radio Relay League presented AMSAT with a check for $305,000. This was

Photo I. Stan Wood WA4NFY and Tom Clark W3IWI discuss one of the GPS antennas being prepared in the AMSAT lab in Orlando.

the result of the ARRL Matching Fund program run earlier in the year to help finance Phase 3D.

Prizes and AMSAT awards finished the evening. The prizes ranged from books, T-shirts and maps to gear from SSB Electronics, 50 copies of Windows NT from Microsoft, and a mobile transceiver.

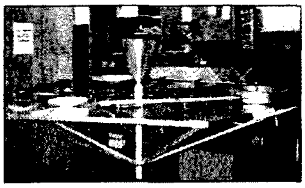

Photo J. A mock-up of the "earth" side of Phase 3D is used to test antenna locations in the lab.

Sunday

Following the Field Operations Breakfast at 7:30 a.m., Bill Tynan started the AMSAT Board of Directors' meeting,

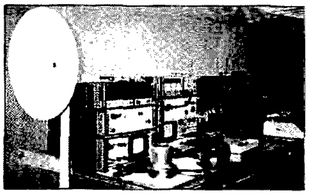

Photo K. One of the test equipment benches in the AMSAT lab in Orlando.

which lasted through mid-Monday with a few breaks for food and sleep. The agenda covered many items including publications, SAREX, the DSP project status, long-range planning, commercial relationships, new satellites and the budget.

The Phase 3D program was the main topic this year. AMSAT still has a significant challenge ahead to pay its part of Phase 3D and maintain other activities. Work on fund raising will continue to dominate AMSAT's operations until launch.

Parallel to Sunday's BoD meeting, guided tours were provided of the AMSAT lab facility at the Orlando airport. A chartered bus furnished transportation for those interested in viewing the progress on the satellite and improvements to the lab. Many displays and demonstrations were provided.

Tucson, Arizona, is the site for the 1996 meeting. It is sure to be a fascinating event since Phase-3D will be completed and waiting for launch. Don't miss the Friday talks. Be sure to come early. Copies of the *Proceedings* of the symposium are available from AMSAT or the ARRL. The book is 8 1/2" by 11", 182 pages, and softbound. It's well worth the cover price of $12.00. AMSAT can be contacted at 1-213-589-6062 for details on shipping charges.

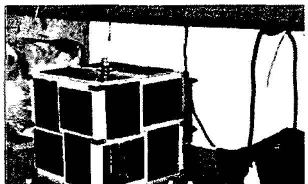

Photo L. A microsat model from five years ago resides in one corner of the AMSAT lab in Orlando.

Straight Key Night

For many years the ARRL has sponsored Straight Key Night (SKN) on New Year's Eve and New Year's Day. In

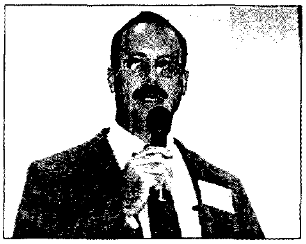

Photo M. Steven Bible N7HPR discussed Internet connections for satellite telemetry monitoring and future modes for digital satellite communications beyond Phase 3D.

1972, a group of satellite chasers decided to try their hand at some straight key CW via OSCAR-6 during SKN. The idea caught on and the tradition has been maintained whenever there has been a satellite available for the event.

AMSAT Vice President of International Affairs Ray Soifer W2RS invites interested satellite operators to participate in the 24th annual SKN via OSCAR. He reports that there are no rules, no scoring, and no need to send in a log. Just call CQ SKN in the CW passband segment of an OSCAR between 0000 and 2359 UTC on January 1, 1996, or answer a CQ SKN call from another station. Contacts via the moon also count. Nominations for best "fist" can be sent to W2RS@WA2SNA.NJ.USA.NA via packet or to W2RS@AMSAT.ORG via the Internet. You can also use his Callbook address.

Number 58 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
6 Jenny Lane
Baltimore MD 21208

I guess I should begin this month by paying attention to the date on the cover of the magazine, and wishing each and every one of you a *Happy New Year!* My most sincere wishes for a Healthy and Happy 1996 to all of my readers. With this interest in time, I have several items of interest to the ham paying attention to this detail of our lives.

To begin with, a new program has hit the market, called WinZones, billing itself as a "comprehensive time zone utility for Windows." Produced by Extend, Inc., in Pleasanton, California, the program generates a number of customizable clocks on the Windows desktop. It is available in versions for both Windows 3.1 and Windows 95, and I have reviewed the Windows 95 version.

As you can see in Fig. 1, the program's window can be filled by a clock, either analog or digital, which may be set to any time zone. A variety of cities are provided in a data file, which allows the generated clocks to highlight time zones around the world. The four clocks from my screen demonstrate the degree of customization possible. Clocks may be analog, using Arabic or Roman numerals, or digital. Typefaces, size, and color of the clock may all be changed at will. There is even an alarm function, indicated by the red arrow on the Jerusalem clock in the Fig. 1, that can be used for any purpose where an alarm might come in handy.

Indicators on the clock face indicate daytime or nighttime by a little tree in the sun or moon being displayed, and daylight savings time may be activated individually for each clock to allow for differences in daylight savings time observance in different areas.

The program installs easily, using the common "a:setup.exe" routine. It opens the Setup Wizard, which quickly steps you through the installation process. Although the program configures itself to open with four clocks, this is quite easily changed to whatever your heart desires. Additional clocks may be opened on the fly, so to speak, and closed again without affecting the rest of the program.

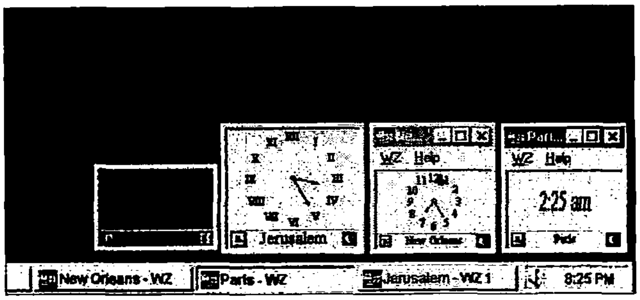

Fig. 1. A WinZones screen in Windows.

Unfortunately, uninstalling the program is not so easy. While there is an uninstall routine, as required of Windows 95 compatible programs, it fails when called, indicating that it cannot find the uninstall log file. Since all the files appear to be installed in one directory, erasing that directory effectively gets rid of the program. However, I cannot tell, at this point, if there are not some scattered INI files, pointers, or registry data remaining.

In short, if you have a need for several clocks on the screen at one time, WinZones may be just what you are looking for. Windows 95 comes with a clock of its own, on the taskbar. So, if you have no trouble converting from local time to GMT or the time zone of your current contact, this product may be overkill. If you are interested, contact Extend and tell them you read about it in "RTTY Loop."

Now, if all you want is an analog clock on the screen, instead of the little digital taskbar icon, check out rclock.exe, one of the "powertoys" from Microsoft. Available free on the Microsoft Home Page, as well as other bulletin boards near you, this little darling puts a round clock on your screen, through the magic of Windows 95's sophisticated windowing system. Of course, you can configure it to be a digital clock as well. While you can't use it to put multiple clocks on the screen, and it can only display the system clock time, it may be all you need. If you want this little darling and can't find it in your neighborhood, I wouldn't be surprised if it didn't turn up on a RTTY Loop Software Collection disk, real soon!

With all these clocks, you might want to know what time it is — for real! That need takes us to our web site of the month, a page which will give you the correct time, down to the fraction of a second, direct from the U.S. Naval Observatory Master Clock. Point your web browser to: http://tycho.usno.navy.mil/what.html and you will see a Daliesque graphic and a button to push. Pushing the button will give you a spread of times from a variety of sources. Given the delays inherent in the communications system, I would not calibrate a clock to the hundredth of a second, but it is more accurate than that sundial in your backyard. Enjoy!

Albeit a bit late for some of you, my apologies to anyone I have kept waiting for either a list of programs or software collections. While I would like to spend most of my day on ham radio or computers, the demands of my practice, family, and other pressures occasionally delay my responding to your inquiries. By the time this column is published, I should be pretty much caught up. If you have been waiting for my response for more than a month or so, feel free to drop me a line, I may not have received the original request.

Work is progressing on setting up a RTTY Loop Home Page on the web. Stay tuned, by the time this column is published it may well be online. Try one of the search engines and see, you might be surprised. In the meantime, the RTTY Loop Software Collection continues to grow. Get the latest list by sending a stamped, self-addressed envelope to the address at the top of the column, or by E-mail to me on America Online (MarcWA3AJR), CompuServe (75036,2501), or via the Internet (marcwa3ajr@aol.com). Then again, if you're lucky, maybe you'll be able to download it from a home page yourself!

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
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Peterborough NH 03458

Mail Call!

This month, I'd like to devote the column to answering some questions. Keep those letters coming, folks, but please don't include SASEs; I just can't answer letters personally. Those relevant to the column will be discussed here in the magazine. Here goes:

Dear Kaboom,

I recently bought a Radio Shack DX 390 receiver and am now thinking about greater involvement in ham radio. I was excited by your article in which you discussed how computers can be integrated into one's shack. I have a Mac Plus with 4 Megs of RAM. How are computers actually used in ham radio, and what kind of software is available?

Getting My Feet Wet

Dear Wet Feet,

The computer has loomed as the greatest advance in ham radio since sideband and FM came along. How do we actually use computers? Lots of ways! They depend, though, on what facets of ham radio intrigue you. You mentioned you were interested in CW and packet. Packet is, of course, a computer mode right from the word "go." In packet, you can use your computer as a terminal for a separate hardware TNC (terminal node controller—the thing that actually makes and decodes packets), or you can save some money and use the computer as the TNC itself. That's how I do it here, because it saves me the cost of a TNC. Several "software TNC" programs which let you do that are available for the PC, and there's at least one for the Mac. Some of the PC programs are Baycom, Soft TNC, and Poor Man's Packet.

[*See "Packet on the Mac," in the October '92 issue of* 73. *In the article, KD6CMT mentions a Contol Panel called SoftKiss which emulates a TNC in KISS mode. KD6CMT suggests using it in connection with NET/Mac, available through America Online and other online services. Reprints of the article are available for $3.00.—ed.*]

Using a computer as a TNC requires adding a small modem. You can buy one for about $50 (considerably less than the price of a hardware TNC), or you can build one, which will be a nice introduction to the technical side of the hobby. I built mine for about $20, and it works fine.

As for CW, there's all kinds of public-domain software that will help you. You can get study courses with audible practice drills. You can also get programs which will actually key your rig and send CW, and some can even receive it pretty well, showing the decoded characters in plain language on your screen! Truthfully, though, CW is not the most machine-friendly mode; if you practice, you can learn to receive Morse more accurately than a computer can. Besides, it keeps your skill up. I do have both transmit and receive on my CW program, but I never use the receive. Still, the transmit function saves a lot of wear and tear on my arm, and lets me send better code than I could with my iambic keyer. It's not as much fun, though.

If you get into contesting, logging programs can help you avoid dupes (duplicate contacts with the same station). And, when you're done, you can have the machine print out your logs, ready for sending in for your awards. I don't care for contesting, so I don't use anything like that. But, many noncontesting hams still like logging programs, simply because they make it easy to keep track of contacts. It's quite nice to answer a CQ ("calling anybody") and call up notes regarding the last contact with the same station. The other ham will sure be surprised when you say, "Hi, Bill, how's your dog's arthritis these days?"

If you get a CD-ROM drive for your Mac, you can install a callbook database that'll let you look other operators up by their callsigns. Especially if you want to QSL (exchange reception report cards), that

can save a great deal of time and effort on the air, because you don't have to exchange addresses.

Particularly because you're just getting into the hobby, you'll find your computer very useful as a study aid. Any ham-oriented BBS should have lots of exam simulators and study guides to help you earn your license. Good luck, and I hope you're on the bands soon!

Dear Kaboom,

The schematic in your article for the Kenwood MC-85 microphone modification did not show the resistor numbers for the 22k and 4.7k resistors. Also missing is the capacitor number for the cap between IC1 pin 2 and the 22k resistor. I'd like to modify my mike to work like yours, but I can't figure out the conversion without those numbers. Can you help?

Missing Info

Dear Missing,

Sorry about that! Somehow, those numbers got removed from the diagram. Here they are: The 22k is R9, and is connected between the wiper of the compression control (VR2) and IC1 pin 6. The 4.7k is R23, and is connected between one end of the same control and ground. And, the 3.3 µF cap is C8, and is connected between IC1 pins 2 and 6. Hope that helps.

Dear Kaboom,

I've been off the air for months, due to a failure of the MRF 485 driver transistors in my Kenwood TS-930. I was told that Motorola no longer makes these transistors. I tried a pair of NTE 236 transistors, which are listed as replacements, but they promptly failed. A Kenwood technician told me that the company does have a replacement transistor, but he no longer does these repairs. Also, there are other modifications necessary. Is there a retrofit?

Unwillingly Silent

Dear Silent,

My ECG cross reference lists these as ECG 236. I haven't heard about the retrofit problem, but it would pay you to try and get that Kenwood tech to send you the details of the required modification. Probably, it's just the addition of a capacitor or something similar. I suspect, though, that the NTE 236s failed for another reason. Most likely, both they and the original parts blew because something else is wrong. If I had to guess without actually seeing the radio, I'd wonder about your final transistors. Are you sure they're not shorted? Drivers usually don't go when the finals are good, and shorted finals will blow drivers faster than you can hit the "off" switch. Before investing in yet another pair of drivers, check those finals. Also, try RF Parts Company, (619) 744-0900, and see if they have any other replacements for the MRF parts. They carry all kinds of RF power transistors.

Dear Kaboom,

I enjoyed your articles on oscilloscope use. I picked up a scope at the last hamfest, but I don't understand one thing: when I hook my probes to the calibrator terminal, I get a nice square wave as long as the probe is in the X1 position. When I set it to X, though, the wave looks like something from outer space! It has big spikes at the top and bottom which then slope inward gradually to the end of the wave. Did I buy a hamfest nightmare?

Puzzled

Dear Puzzled,

Nope! Your scope is fine. It just watches the X-Files too much! Seriously, though, all that's wrong is a simple adjustment, and you don't even have to open up the case to do it. Take a look at your probe and you'll see a little hole with a screwdriver adjustment slot in it. Usually, it's on the part you hold, but it may also be on the part that plugs into the scope. This adjustment sets the capacitance of the probe when it's in the X10 position. Due to the very high input impedance of about 10 megohms, the amount of capacitance has a great effect on the resulting waveform. Just set the probe to the X10 position, connect it to your calibrator, and adjust the probe's trimcap until the waveform straightens out. You'll find that if you then use that probe on the other channel, you'll have to readjust it; that's how critical that setting is! By the way, that's why calibrators have square waves, instead of just supplying calibrated DC voltages with which to set the channel gain.

Until next time, 73 from KB1UM.

Number 60 on your Feedback card

Carr's Corner

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Another Potpourri

Several times a year I clean up my "in box" and take on a few topics that are not worth an entire column, but are of interest to readers because most of the ideas came from questions or comments in my mail box. Which brings up a little housekeeping matter. You can reach me at my post office box (P.O. Box 1099, Falls Church, VA 22041), or by Internet E-mail at carrjj@aol.com

Science Fair Project for a Radio Buff?

One of the topics that I've written about extensively over the past five years is what I call "radio science observing." This coined term refers to radio astronomy, propagation observations, and VLF SID (sudden ionospheric disturbances) hunting. The latter requires a VLF receiver, which can be built using low-cost components. VLF SID hunters look for the effects of solar flares on the ionosphere.

Because the distance between the Earth's surface and the bottom of the D-layer of the ionosphere is only a few wavelengths in the 15 to 30 kHz band, a sudden increase in ionization (as occurs during a flare event) causes that space to act like a waveguide at VLF frequencies. A friend of mine uses a geiger counter to record solar flare events. He looks for sudden increases in background radiation levels. It might be interesting to look for solar flares using both the VLF receiver and the geiger counter, and note what correlations do or do not exist.

If you do not own a VLF receiver, and are not inclined to build one, then you might wish to consider using the shortwave bands. The HF shortwave bands are not the best bet because there is a lot of variation in those bands under the best of circumstances. But you can make some recordings using the apparatus described below.

The trick is to monitor a station that stays on the air most of the time. The National Institutes of Standards and Technology (NIST) radio stations WWV (Colorado) and WWVH (Hawaii) are pretty good bets. Try monitoring the 5, 10, or 15 MHz signals.

Recordings can be made with either a strip chart recorder (which can be obtained relatively cheaply on the used market), or by using an A/D converter feeding a receiver. Although A/D converters were once expensive toys, one can now buy them relatively reasonably. There are models that will plug into the parallel printer port on the back of your computer (yep, that's what I said...the parallel port). These devices use the four bidirectional handshaking lines to take in the A/D signal. Others are available that will plug directly into the RS-232 serial communications port on the back of the machine. Radio Shack now offers a digital multimeter that contains a computer interface, and the software to drive it. This meter can be used as a data acquisition A/D converter.

Doing radio science observing may seem like a waste of a computer, but today you can buy non-Windows PCs for a song and a heartbeat. I've seen 286 machines sold for $10 by a local hospital that had just upgraded to 486-DX4 machines. The used ads, hamfests, and local used computer stuff stores can sell an '80s vintage PC-XT class machines for $50 to $100, and 286 machines for a bit more. I recently bought a 386-33 machine at a local used computer stuff shop for $200 complete with monitor. So, as you can see, setting up a monitoring station need not be terribly expensive.

Fig. 1 shows the circuit needed to obtain a DC signal that is proportional to the signal strength. Of course, if you can get to the receiver's automatic gain control (AGC) signal, then use it. But that's not so easy as it was when I was a Novice, so many readers will want to opt for the circuit shown in Fig. 1.

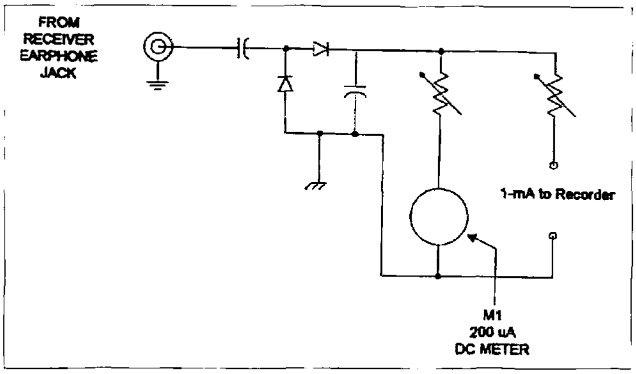

Fig. 1. Audio-to-DC converter for recording signal levels.

This circuit has two parts: a rectifier and an integrator. The rectifier is a voltage doubler type that uses two capacitors and two diodes. The capacitors are each 10 µF units (the straight line side being positive), while the diodes are 1N60 germanium signal diodes. That may surprise you in this silicon era, but those 1950-type diodes are preferred in this application because of the lower voltage drop (0.2-0.3 volts rather than 0.6-0.7 volts) compared to silicon diodes. Radio Shack and other sources still offer 1N34 and 1N60 diodes, usually in a blister pack of about a gozillion diodes for a few bucks.

The integrator produces an output that is the time average of the input signal, so it tends to smooth out very short variations in the signal (e.g., noise spikes), leaving the signal strength variation component. There are actually two methods of "integrating" this signal in this circuit. First, the action of the output filter capacitor, which is also part of the voltage doubler circuit, tends to smooth variations. The second factor is the inertia of the meter movement and the recorder pen assembly.

Levels to the meter and (if you use it) the 1-mA recorder assembly can be controlled with potentiometers. I found that signals' levels are generally sufficient to use nearly any potentiometer from 10k to 100k. In my case, I had a pair of likely 25k linear taper potentiometers, so I pressed them into service.

By the way, if you or some youngster you know is busy with the science fair activity in their school, then you might want to provide them with a copy of my book *The Art of Science* ($19.95, HighText Publications, P.O. Box 1489, Solana Beach, CA 92075; 1-800-247-6553). The chapter on winning science fairs is worth the price of the book alone. Besides, the rest of the book will tell them how to do science and how to handle data.

Bill Orr W6SAI, whom any honest technical writer today will recognize as the guru of gurus, was extremely complimentary in a review of the book in another ham magazine. He was especially enthusiastic about the chapter titled "Counterfeits of Truth," which deals with the logical fallacies. If you have any interest at all in intellectual honesty, then you might want to bone up on the fallacies...and compare with the news media and our politicians.

Low-Pass Filters

A low-pass filter (Fig. 2) is needed by nearly all ham operators who use the HF bands. Harmonic energy from our transmitters will clobber other services, notably television and FM broadcast radio bands (those frequencies that are harmonically related to the ham band frequencies). For transmitter harmonic suppression we would usually want to simply buy a 300-watt or 2,000-watt low-pass filter and be done with it. Those filters have a cut-off frequency between 30 and 40 MHz, so offer a substantial amount of attenuation in the 54-MHz, and up, band occupied by the television stations.

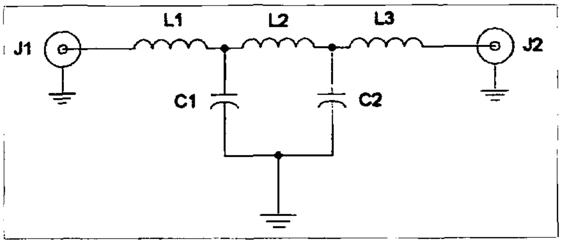

Fig. 2. Low-pass filter circuit.

But what do you do if you want to make a filter for another frequency? For example, suppose you wanted to build a 3-kHz audio filter for use as at the input of the speech amplifier in a transmitter, or at the output of a direct conversion receiver. Well, you build a circuit such as Fig. 2. One way to design your own filter is to look for a "normalized" design, and then frequency scale it. Such filters will show the values for some frequency such as 1 Hz, 1 kHz, or 1 MHz, and then you scale it by dividing the printed component values by the actual 3 dB cut-off frequency you want. That's the way my "FilterMaker" software works. Crude, but you get results.

But what do you do if you don't want a 50-ohm filter? Most of the tables published are for filters that have 50-ohm input and output impedances, which is the standard for RF systems. But in those audio cases mentioned above you might prefer to use 1000 ohms rather than 50 ohms. Also, if you design circuits for the NE-602 chip, you can avoid the use of impedance transformers at the input and output terminals (pins 1/2 and 4/5, respectively) if you go ahead and design the filters for the 1,500-ohm impedance offered by the NE-602 device, rather than 50 ohms.

The 1996 edition of *The ARRL Handbook for Radio Amateurs* holds the solution for you. On page 16.6, the circuits for both capacitor input and inductor input low-pass filters are shown, along with the table for the 1 radian/second, 1-ohm capacitor and inductor values. You can use the equations shown in the article to calculate the values needed for the specific frequency and input/output impedances that you need for your application.

The *ARRL Handbook* has a software diskette accompanying it which makes the calculations a little less tiresome for those for whom a first course in high school algebra was more traumatic than using up a little hard drive space.

It came as a bit of a shock when I ordered the *Handbook*. It's been a couple years since I bought a copy, so I was a little taken aback by the $38 price tag. That's more than ten times the price I paid for my first *ARRL Handbook*...which dates me a bit, doesn't it??? You can get the *ARRL Handbook* from local ham stores or from the Uncle Wayne's Bookshelf (see ads in this magazine). 73

Number 62 on your Feedback card

Hams with Class

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Energizing Experiments

There are lots of obvious good reasons for including a unit on energy in your ham radio curriculum. While lining up my guest speakers for my classroom this term, I decided to invite a spokesperson from our local electric utility, Con Edison. Guest speakers are always a good idea. They bring a change of pace and face for the youngsters, or to whomever your daily audience is. We wound up having several assembly programs being given so that other children besides the ham radio students could benefit from the visit. Here are some of the experiments the children seemed to enjoy the most.

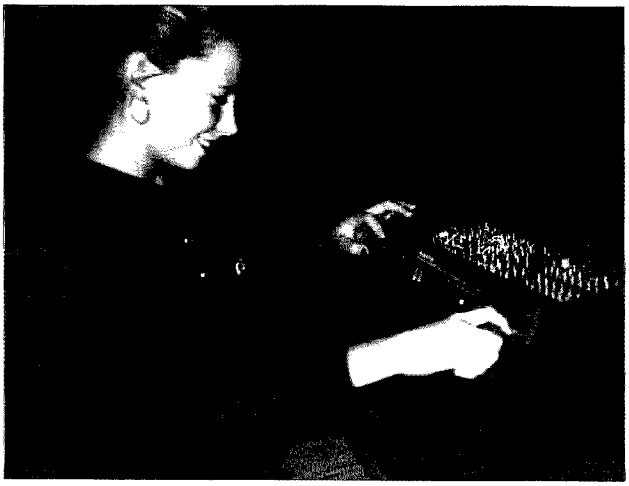
All of us know that energy is a big part of our lives. Scientists define energy as the ability to do work. There are many forms of energy; for example, there are heat, light, electricity, movement of air, water, and machines, and gravity (the earth's pull). There are many sources of energy; for example, there are fossil fuels, hydropower, nuclear power, and solar power. Sheets of paper were distributed for the students to list the ways in which energy makes their lives better. It was pointed out that some energy sources are limited and costly. That's why conserving energy is so important. After the experiments were completed, the children were asked to add to the list they had made.

The first experiment dealt with conduction. The materials needed are: hot water, shallow pan, metal spoon, wooden spoon, plastic spoon, and a glass rod or tube.

Background:

Heat is an important form of energy in the home. Heat is "molecules in motion." Molecules are particles that are too small to see with the eye. All things are made of molecules. They move back and forth slowly at cool temperatures—faster at warmer temperatures. Heat can move by conduction—heat passing directly from one thing to another through touch. Convection is when something heats air (through conduction), which then rises, carrying the heat elsewhere. Radiation is invisible "heat rays" which carry heat away from something. (No touching of objects or movements of air is needed.)

Homes, schools and other buildings lose heat in cold weather, and gain heat in hot weather by conduction. Heat is "conducted" through walls, doors, windows, etc. In this experiment you'll "feel" conduction at work.



Many spin-off lessons come after a guest speaker has visited a ham radio classroom. Here's Kristy, 8th grade.

Procedure:

1. Pour about 1 inch of water in the pan.
2. Place the spoons and the glass rod or tube in the hot water. Which object do you think will become the warmest?
3. After 2 minutes, remove the objects from the water. Which one feels the warmest? Which one feels the coolest? Children were asked to explain why on their papers.

Hands-on experiments can be "energizing." This is Mohammed, 7th grade.

This was a really simple experiment designed for lower grades. Of course it can be adapted for older classes accordingly.

How To Figure Electricity Costs

The next activity led to several spin-off lessons in math and science. "How To Figure Electricity Costs" brought us many favorable comments from the parents. Materials needed: classroom lighting information (wattage and number of bulbs in the classroom).

Electricity is a form of energy used widely in homes, schools, and other buildings. Choice and use of lighting and appliances affect electricity costs. This experiment will give you a rough idea of how electricity costs are determined.

Procedure:

1. Find out how many light bulbs are used to light your classroom.
2. Find out how many watts of electricity each bulb uses. (More watts means more electricity is being used.)
3. Total the watts. Be sure to include the watts for each bulb.
4. Divide the total by 1000.
5. Multiply your answer by the average number of hours the bulbs are left on during each school day.
6. Multiply your answer by the number of school days in the year. This will tell you roughly the number of "kilowatt-hours" of electricity the lights will use in the school year.

If each kilowatt-hour costs 10 cents, about how much does it cost to light your classroom for the year? Can you think of two ways to cut lighting costs in school and at home?

The students enjoyed running all over the classroom, jotting down the wattage information. More importantly, it made them aware that there is a real cost to consumption of electricity. 73

QRP

Low Power Operation

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Tattooing Yaks

Well, another new year. It's a perfect time to start new projects, and plunge into the unknown. John N8ZXB and Scott N8JSK have taken up tattooing Yaks. A rewarding and highly satisfying hobby—as Scott calls it.

I am not into Yaks, but I do like to play with digital panel meters. In the past, I've mentioned the DI International DPM5035L as a rather diverse DPM. So, to start out the new year, I'll show you what I've been doing with this meter.

Instead of displaying a voltage obtained from a power source, I've been trying to marry the DPM to a microstrip RF pickup. Up to a certain point, I've been making some progress. Here's the basic idea.

The first thing required is some way of picking off a small amount of RF coming out of our rig. I have been working on several methods, but the stripline seems to work best for me. In fact, my first attempt was in using a defunct CB SWR meter. It had the proper power capacity and the meter had a microstrip already in place. Instead of using PC board copper traces for the actual micro lines, the CB SWR meter used two large copper wires placed in parallel to a single conductor carrying the RF from one connector to the other. It required only a few cuts with the side cutters to remove the unwanted parts. I kept the metal case and added some .001 feedthrough capacitors between the RF section and the digital section.

The diodes used in the original meter were 1N914s. I replaced them with two hand-selected 1N34As. Better diodes are available for this purpose, but I had those guys in hand.

The DPM has a input impedance of over 100 megohms, so loading of the sensor would not be a problem. A two-position switch allowed me to select either the forward RF position or the reflected power position. The meter will not read out SWR, but rather the voltage generated by the forward RF and the reflected voltage caused by any standing waves on the feedline and antenna. To read the actual SWR, a graph would need to be constructed to show the voltage generated by the reflected RF. Of course, the voltage would only be correct at a specific RF output. This is something I have not done. Common sense should instantly tell you the higher the reflected voltage the higher the SWR is on the antenna system.

Problems

Even with an input of 200 mV, the resulting voltage developed by my QRP rig, did not generate enough for a large reading. The reflected reading was even weaker, as it should be.

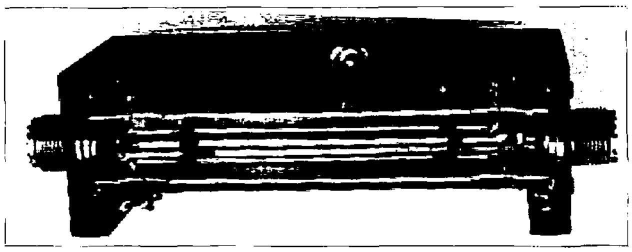


Photo A. Michael Bryce digital panel meter with microstrip RF pickup.

Looking back, the microstrip is probably not the best thing to use at HF frequencies. Instead a toroid pickup would be better. I could modify the transformer's secondary to increase the resulting voltage generated by the RF passing though the core. I also figured the toroid would be more frequency tolerant.

I ended up using an RF pickup from a an old project I had laying around. I used one of many classic RF sensor projects, many of which are in the *ARRL Handbook*. My pickup will generate both the forward and reflected voltage generated by the RF flowing through it. Everything goes inside a deep drawn aluminum box. All leads leaving the box go through .001 feedthrough capacitors, which I might add, are getting harder to come by.

Once the RF sensor had been built, the next step is to increase the voltage developed by the sensor to a usable level needed by the DPM. To do that, I used an op-amp as a voltage amplifier.

Having spent most of a Saturday night working on the the voltage amplifier, I found that the popular 741 op amp did not provide a low enough offset with no signal. So, a LTC1001 op amp by Linear Technologies was put into use. An OP-07 op amp may also be used, but are much harder to come by. Digi-Key stocks the LTC 1001. The LTC1001 is about $2 a pop.

Instead of sweating blood trying to come up with a dual-voltage power supply, I cheated and used two 9-volt transistor batteries. A third battery is used to power the DPM. This DPM must have its own power source. A junk box 3PDT switch is used to turn off the project. If you don't happen to have a 3PDT switch, just leave the DPM on as it should operate for the shelf life of the battery. That's not the case with the op amp circuit.

Projects

In Photo A, you'll see the final result of my work. Again, let me state this is *not* a finished project. There is enough information for you to pick up where I have left off. This is not the last word in a digital SWR meter by any means.

I have also tried to add the second circuit to the DPM. Rather than reading the voltage produced by the RF sensor, I tried to make a digital field strength meter. In its simplest form, the meter will display the resulting voltage developed by the detector. Again, an op amp is used to up the voltage to a more suitable level.

Notice, the field strength meter has no tuned circuits. In fact, it has a response from DC to light. By adding some tuned circuits, one should be able to sniff out RF on a very narrow frequency range. If you like twisting knobs and dials, then insert your tuned circuit before the detector and the antenna. Use shielded coils to prevent unwanted pickup from coil to coil. Digi-Key stocks a large assortment of RF coils in their catalog. A plastic AM broadcast 365 pF variable capacitor from a defunct transistor radio would make an ideal capacitor to tune the circuits into resonance while keeping the size of the field strength meter down.

There is still one more project I wanted to try with the digital meter but have not had the time. I wanted to measure the voltage developed across a dummy load and then display the result. In theory, it should work. In Fig. 1, a simple RF detector, will convert

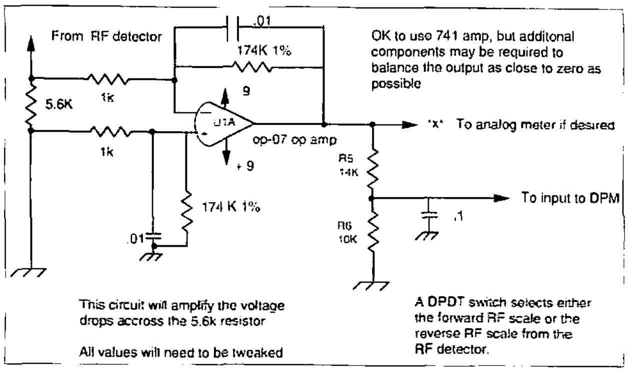


Fig.1. Schematic of the DPM.

Welcome Newcomers

Wayne Green W2NSD/1

When I saw the FCC's license figures for the last 10 years I could see that we'd had a substantial increase in Techs, hut it wasn't until I drew the graph you see here that I grasped the full extent of what has actually happened. Check it out and let the message sink in.

The graph explains several things: (1) Why hamfest attendance has dropped so much in the last few years; (2) Why our ham dealers and manufacturers are really hurting for sales; (3) Why our ham bands seem less crowded than they did 30 years ago.

The General Class license numbers have increased at about 1.1% per year over the last 10 years. But when you consider that the FCC admits that over 40% of the old licensees are not renewing when their tickets expire, that looks like a possible loss of 4% per year! The obvious fact is that the no-code Techs, with pitifully few exceptions, are just not interested in upgrading. Our repeater system is much better than the 40 channels of CB, and that's all they seem to want in life.

And that means that *Radio Fun* has failed in its mission. We haven't been able to sell the current newcomers on the great fun amateur radio provides via satellites, building kits, packet, ATV, SSTV, RTTY, DXing, DXpeditions, foxhunting, ham clubs, and so on. I don't run any of my businesses just to make money. They all have a mission, so I'm discontinuing the publication of *Radio Fun*. Maybe this will allow me to spend more time pushing cold fusion, which has a far greater potential for benefiting the world.

Can anything be done to blast these ex-CBers off 2m and into General tickets? I'd like to see some

> ***"Get on from there and work 10,000 J's in a week, and you'll see what good operating sounds like."***

clubs make an effort to (a) get these guys to come to club meetings; (b) provide them with upgrading classes; (c) send me photos of their graduating classes, along with stories on how they did it.

We can't win this by hassling the Techs. Ridicule won't work either. What we have to do is get them interested enough in what the HF bands have to offer to get them to go for a General or Advanced ticket. That's why I've been harping about our setting up crossband repeaters, making club meetings more fun, getting some zing into the club newsletters with reports on what hot DX some members have worked recently, and anything else exciting that the members have been doing.

I get a lot of club newsletters, but I don't recall seeing one with a request from the editor for the members to write about anything exciting they've done in the hobby. Amateur radio has provided a lifetime of excitement for me, which I try to share with you. If I can get on the air from South Yemen, so can you. It didn't cost me anything because I kept my eyes open and grabbed the opportunity when it turned up. I keep asking you not to just enjoy life's merry-go-round, but reach out for that brass ring. You can get it, but only if you really reach.

When I started *73* I put every nickel I had into the first issue. I didn't start out rich. I wasn't a great student in school. Heck, I just barely made it with C's. It was ham radio that pushed me to go to a technical university. It was ham radio that got me into the Navy as an electronic technician. Later a RTTY chum got me a job on a Guggenheim grant, working on a color organ. And another RTTYer got me a job as the head of the Music Research Foundation. My hamming got me into broadcasting as an engineer-announcer, and then into TV as an engineer, cameraman, then a producer-director. It was RTTY that got me into publishing.

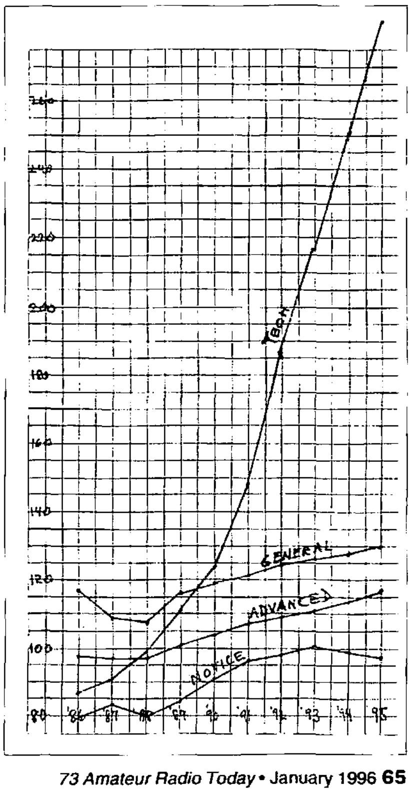
We know that the key to making money lies in technology, and we also know that hamming makes it fun to learn about electronics. As transportation costs drop and communications systems improve and get cheaper, unskilled people in America will be more in direct competition with unskilled workers in the lowest-wage countries of the world. So we're going to see more and more of a difference between what educated and ignorant people earn.

I do get upset over the bleeding heart liberals taking my money and giving it to people who spurned the free education they were offered, thereby guaranteeing themselves poverty unless they go into crime. Grumble.

I want to read in club newsletters about the clubs descending on their local schools like locusts and getting the kids interested in hamming. I want to see them never-say-die on getting the new Techs in their area to upgrade.

I'd hoped that I could make a difference with *Radio Fun*. The hams I did get to subscribe liked it a lot. I think we had one of the highest percentages of renewals in publishing history. But, as I explained, I've never had any interest in doing something just because it makes money. If it isn't going to somehow be a benefit to mankind, the heck with it.

Look, the ARRL obviously isn't going to do anything about this, and I've failed, so it's all up to you. Start seeing what you can do to get these Techs to upgrade and have some fun with us on the low bands. Get 'em on packet, satellites, or maybe a DXpedition to South Yemen. It's been a while since I operated from there. Or perhaps New Caledonia, where the local hams are very friendly and will lend you their stations, so you don't even have to carry your rig and antennas along. Get on from there and work 10,000 J's in a week, and you'll see what good operating sounds like.



the RF across the dummy load and then output the result as a DC voltage proportional to the input. The old Heathkit Cantenna has such a circuit built inside a small box mounted on the dummy load lid. As a matter of fact, I plugged into the output jack of my Cantenna and was able to display a reading on the DPM. Again, a graph could be made to compute the number displayed on the DPM into something more useful. Or, if you wanted to get really mad and wild, a small embedded microprocessor such as the PIC 16X series could be programed to convert the incoming voltage into something really useful on a LCD display

For those of you who want to experiment with the digital SWR meter, I have some of the D1 International DPMs in stock. They're $30, and that includes first class shipping. Send to my attention at the address at the top of the column.

Major Project Plus New Rig

As I write this, I am about to undertake a major project—cleaning off my work bench! For sitting on a table in the next room is a TACP1 by S&S Engineering. This rig is the first synthesized QRP transceiver to come from S&S Engineering utilizing a tuning knob for frequency selection. This is the second version of the TACP1. The first model was available only on the 80 meter band. There is now a TACP1 for 40 meters, the bread and button of most QRPers. Stay tuned for a full-blown review of this exciting new rig.

Communications Simplified, Part 1

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If you're into ham radio, then you are already into electronic communications as well. But if you are a beginner, or if you've limited yourself to contesting or chatting on your local repeater, you've probably missed out on a lot of the more interesting technical parts of communications. This series of articles will try to bridge that gap, but in a simple (and hopefully interesting) way.

These articles are the result of a community college course I have been teaching for some years. Since I haven't been able to find just the right textbook for my course, I've decided to write my own course notes. Eventually, these notes will become a textbook, but for now you're looking at just the notes.

But don't be scared by the idea that this comes from a college course—it isn't as complex as you think. First of all, I teach a survey course. That means that it's an introduction to communications for students who haven't taken any other communications courses before. So it starts fairly simply, and doesn't assume a lot of previous knowledge. In those areas where it assumes some knowledge from a prior course, or where it seemed like a good idea to discuss some related topic, I've inserted what I call "detours"—short discussions that temporarily break away from the main subject.

Second, I teach a survey course that tries to cover a big area in just one semester. That means that there isn't time to go into tremendous depth on any one topic. Hence, we have to stay fairly simple at all times. The course has a lot of descriptions and pictures, and almost no math.

Third, this is a community college course in the second year of a technical program. It's intended for students who will become technicians, not engineers or mathematicians.

Finally, Wayne has made me promise not to show off with fancy formulas and theorems, and to add a little sugar to make the material go down easier. (I guess that means I have to crack a bad joke now and then, such as "What do you get from a Mafioso college professor? An offer you can't understand!")

But before I start off, let me add a little fine print for the benefit of the many readers who probably know a lot more about this subject than I do. Please keep in mind that these articles are intended for beginners. As such, I will often provide explanations that may seem a little (maybe *very*) simple-minded to you. While my explanations will not be *wrong*, they may be very *incomplete*. Please don't barrage me with long treatises and reprints from other texts and journals if I've omitted or simplified too much (but do let me know if I say something that isn't true).

So let's get started.

Communications

Communications is simply the moving of information from one place to another.

An English teacher thinks of communications as the process of writing or speaking words, which tell your reader (or listener) something you want him or her to know. There is even something called mass communications, which is sort of like journalism, but for TV, radio, and film. In this course, on the other hand, we think of communications more as the electronic process and equipment needed to send information over long distances.

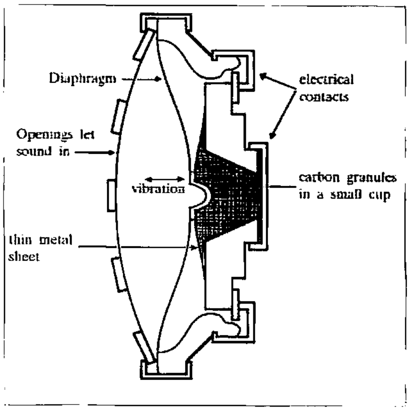

Fig. 1. Telephone-type carbon microphone.

For our purposes, we are interested in three aspects of communications:

- What is being sent? In other words, what kind of information are we sending; is it sound, pictures, or perhaps computer data?
- Through what is it being sent? That is, what is the *medium* through which it goes—wire, radio waves, sound, light, fiberoptics?
- How is it being sent? All by itself as in a telephone wire, or combined with other signals? Analog or digital?

It would be nice to be able to look at each one of these questions separately. Unfortunately, they all interact, and so our discussion will have to flit back and forth occasionally. Still, let's try to start with an orderly approach.

Let's start off with what is being sent. The information you send can be sound, video (pictures), or digital information. Let's look at each in turn.

Sound

Sound is simply the vibration of air. When we speak, our vocal cords vibrate the air coming out; the sound travels through the air until it vibrates the ear drum in someone's ear, which eventually winds up in sending nerve signals to that person's brain.

In electronics, a microphone is used to convert the air vibrations into an electrical signal. The air vibrations move a thin metal or plastic plate

(called a *diaphragm*) inside the microphone; a motion-to-electricity converter then converts the motion into an electrical signal. This signal is amplified and somehow sent from one place to another, and then converted back into air vibrations by a loudspeaker. Both the microphone and the loudspeaker (more often just called the speaker) are called *transducers,* a term describing any device that converts energy from one form (such as mechanical vibration of the air) into another (such as an electrical signal). (See Detour 1.)

In simple sounds such as someone whistling, the resulting waveform may be a sine wave; in more complex sounds the waveform may be much more complex as well.

Let's now look at the output of a microphone on an oscilloscope. What you see depends on the sound that the mike is picking up.

Suppose you stand in front of a mike and whistle a pure note into it (making sure to be far enough away so the mike isn't picking up the sound of the air hitting its front). You'd see the signal shown in Fig. 4. This kind of a wave is called a *sine wave* because of its relationship to the sine function from math.

On the other hand, suppose you whistle another note, but this time an octave higher. The word *octave* is a musical term, meaning eight white keys lower on a piano keyboard. This time you'd see the waveform of Fig. 5.

Both of these waves have the same shape, but the second one goes up and down twice as often as the first. In electronic terms, its frequency is twice as high. More on this in a moment.

Now suppose you do the same thing, but this time look at the signal created by the sound of some instrument such as a trumpet, rather than a whistle. Fig. 6 shows the resulting picture.

The sound in Fig. 6 has the same frequency as that in Fig. 5 (since it has the same number of cycles in a given time period), but it looks very different. A musician might say that it has the same *pitch* (that is, it is the same musical note), but different *timbre* (a different sound quality). Some repetitive sounds (like the pure tone of a flute) have a waveform almost like a sine wave; other repetitive sounds (like those from a violin or trumpet) have a waveform possessing a basic frequency, but which looks much more distorted and "kinky" than a sine wave.

The frequency of a note determines the pitch; two different instruments playing the same note have the same frequency. But they sound different because their waveshapes are different. Finally, note that the amplitude of the wave—its height—determines its volume. Quite often the amplitude of the waveform changes with time. For example, when you play a piano note, the amplitude builds up to a maximum fairly quickly when you hit the key, but then gradually decreases as the note dies away.

Note also that only repetitive sounds (like a whistle or the note of a guitar) have a definite frequency; other sounds (like the beat of a drum or the crack of a whip) do not.

Sound normally involves frequencies from about 20 to about 20,000 Hz, but many people cannot hear that entire range. Children often hear up to almost 20,000 Hz; as you get older, you hear fewer and fewer high frequencies.

When you reach 60 or 70 years of age, you will be lucky if you can hear up to 10,000 Hz. On the other hand, many animals (such as bats or dogs) can hear much higher frequencies than humans can.

Fig. 7 shows the frequencies produced by each of the white keys of a piano. For example, if you look at the note labeled "Middle C," you will note that its frequency is 261.6 Hz. If you then go an octave to the higher—counting exactly eight notes to the right—you get to the next C, which is at 523.2 Hz, exactly twice the frequency. The piano has about an eight-octave range, and its frequencies range from about 27 Hz on the left or bass end, up to almost 4,200 Hz at the right or treble end. Fig. 7 also shows the frequencies produced by various other instruments. For example, the trumpet produces notes only in the range from about 160 Hz up to about 890 Hz.

That brings up an interesting question: If the frequencies of musical notes range up to about only 4,200 Hz (and most musical instruments have even less of a range), why do hi-fi equipment manufacturers stress that their equipment goes up to 15,000 or even 20,000 Hz? The answer has to do with harmonics.

Harmonics or Overtones

So far, we've explained that

(1) The frequency of a sound determines its pitch or tone, and two instruments playing the same tone will have the same basic frequency. That basic frequency is called the *fundamental.*

(2) The amplitude of the sound determines its volume.

(3) The waveshape of the sound is what gives it its tone quality. For example, a trumpet or violin can play the same note, but they will have totally different waveforms; that is what makes them sound different.

Consider, for example, a square wave like Fig. 8. What is it that makes this wave different from a sine wave?

Suppose this square wave has a frequency of 1,000 Hz. An interesting thing happens when we send it through some tuned bandpass filters—that is, filters that let through only one frequency. This is shown in Fig. 9.

When the 1,000-Hz square wave is sent through a 1,000-Hz filter, out comes a 1,000-Hz sine wave! Nothing comes

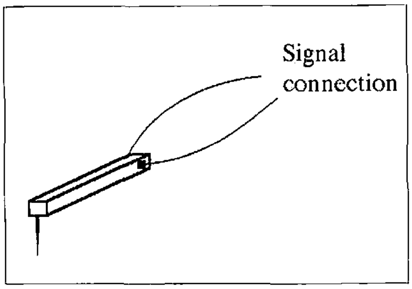

Fig. 2. Simplified crystal phono cartridge.

out of the 2,000-Hz filter, while a small 3,000-Hz sine wave comes out of the 3,000-Hz filter. What's going on!?! (See Detour 2.)

Returning to Fig. 9, we have three filters all looking at the same original 1,000-Hz square wave. We see three things:

• The 1,000-Hz filter outputs a 1,000-Hz sine wave, so there must have been a 1,000-Hz component in the square wave.

• The 2,000-Hz filter outputs nothing; thus, there was no 2,000-Hz component in the square wave.

• The 3,000-Hz filter is also outputting a signal, and we see that it has three times the frequency of the square wave (there are three times as many cycles in the same amount of space); so it seems to be at 3,000 Hz. Moreover, if we were to measure it carefully, we would see that it is exactly one-third the height of the 1,000-Hz sine wave.

If we had more filters, we would see other frequencies as well. Any filter tuned to an odd multiple of 1,000 Hz would show an output, while any other filter would show nothing coming out at all. For example, if we had a filter tuned to 5,000 Hz, out would come a small 5,000-Hz sine wave, and so on.

We can see from this that a 1,000-Hz square wave consists of a large number of components. The 1,000-Hz sine wave is called the *fundamental,* since it has the same frequency as the original square wave. Each of the other components is an exact multiple of the fundamental; the frequency of the 3,000-Hz signal is exactly three times the fundamental frequency, and is therefore called the *third harmonic;* the 5,000-Hz component has a frequency of five times the fundamental, and is therefore called the fifth harmonic. In other words, a square wave consists of a fundamental sine wave signal (whose frequency is the

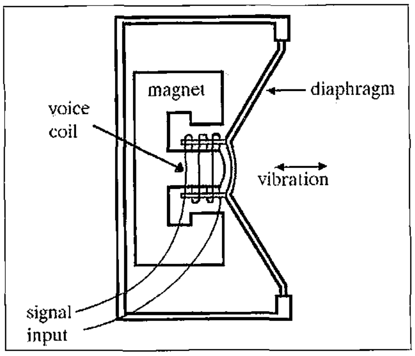

Fig. 3. A telephone-type earphone.

same as that of the square wave), plus a large number (actually an infinite number) of extra frequencies, each of which is an exact odd multiple of the fundamental. We say that the square wave consists of a fundamental plus an infinite number of odd harmonics.

Fig. 10 shows a computer simulation of this situation. It shows a fundamental plus four harmonics (the third and fifth are labeled; the seventh and ninth are not), each of which contributes a little to the output. When they are all added up, we get the wave that looks square shaped, except that its sides don't go straight up and down, and the tops and bottoms are not quite completely flat. The reason it only approximates a square wave is that it has only a limited number of odd harmonics, whereas a perfect square wave requires an infinite number of them.

This is an important concept to understand: The square wave consists of an infinite number of components. Of course, the components have to be just right—they must have the right frequency, the right amplitude, and even the right phase. For the square wave, the rules are fairly simple:

• The harmonics must be exact odd multiples of the fundamental frequency. For example, the 93rd harmonic of a 1,000-Hz fundamental would have to be *exactly* 93,000 Hz.

• Their amplitude must be just right. For example, the third harmonic must be exactly one-third the size of the fundamental; the fifth harmonic must be exactly one-fifth the fundamental's size, and so on, all the way up. Thus the 93rd harmonic would have to be 1/93 the size of the fundamental. This points out that eventually the harmonics get so small that perhaps they can be omitted without making a noticeable difference in the square wave.

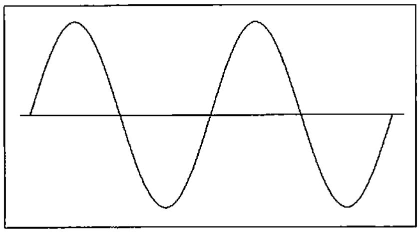

Fig. 4. Waveform of a whistle.

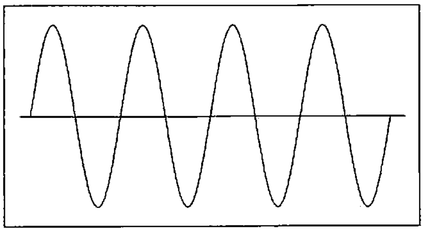

Fig. 5. Whistle waveform an octave higher than that in Fig. 4.

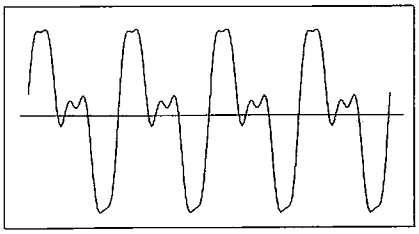

Fig. 6. More complex musical sound.

• Their phase has to be just right. To get the steep rise and fall of the square wave, all of the sine waves making it up have to go up together, and down together, as shown at points *a* and *b* in Fig. 10. If any one of them is out of step, the result will be some wave other than a square wave.

We can extend this concept in two important directions, both of which are critical to understanding many of the circuits in communications:

(1) Just as the square wave consists of a fundamental and harmonics, so *any repetitive waveform consists of a fundamental and harmonics,* although some of these might be missing in special cases. The sine wave is a special case since it has no harmonics at all; the square wave is another, in that only odd harmonics exist, they all rise and fall together, and the harmonics get smaller as their frequency rises. In a more general case, there might be both even and odd harmonics, some harmonics might be large and others small or missing, and they might have all sorts of strange phase relationships. You may have heard of the FFT or Fast Fourier Transform; it is simply a mathematical procedure for finding out what components make up any particular waveform.

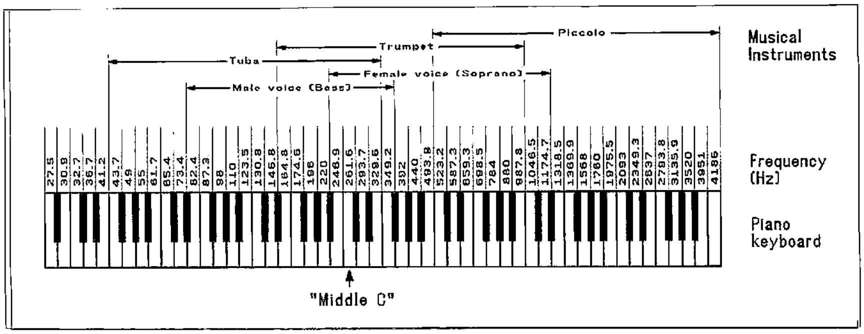

Fig. 7. Frequencies produced by musical instruments.

(2) No matter how you generate that waveform, the harmonics are there even if you don't consciously put them in. For example, one way to generate a square wave is to set up a switch that rapidly switches between a positive and a negative voltage. This setup obviously doesn't put in any sine waves, yet if you look at the square wave with some tuned filters, the fundamental and harmonic sine waves are there.

Let's think about filters again. A filter lets you look for specific frequencies (or colors) in a signal (or in light). But using colored filters to look for specific colors in light is a hit-or-miss proposition if you don't know what to look for; you might need many specific color filters to identify the components in a particular

DETOUR

DETOUR 1

OK, now you see how detours work. Let's detour to talk about transducers. Microphones (also called mikes) come in many different types. Most common is probably the carbon mike, because it is used in every older telephone (the old-fashioned kind, not the newfangled little phones made in the Far East. But not just the real old ones, as in Photo A; more modern ones, too).

Like every microphone, the carbon mike has a diaphragm, which vibrates when hit by a sound wave. The diaphragm in turn moves a thin metal sheet that presses on carbon granules in a small cup. The electrical connection is made to the metal sheet and to the bottom of the cup, as shown in Fig. 1.

The carbon granules are small particles of carbon, which act as a resistance between the cup and the diaphragm. The value of this resistance depends on how closely the granules touch. As the diaphragm vibrates, it alternately squeezes the granules to increase the pressure between them, or releases the pressure. This changes the resistance of the mike in step with the vibrations of the air. The mike is in series with a battery (back in the telephone company's central office, not inside the phone), and thus varies the current in time with the sound. The current variations are converted to voltage variations when the current passes through a resistor or a transformer.

It turns out that a carbon mike has very bad sound quality, but it has one advantage—the voltage variations in the series circuit can be quite large, which means that the electrical signal from the mike can travel long distances without any amplification. This was obviously necessary back in the early days of the telephone, before there were any amplifiers.

Carbon mikes were used in the early days of radio, too, but they were soon replaced by better-sounding mikes.

One inexpensive mike still commonly available is a crystal or ceramic mike. This kind of mike uses a crystal (usually quartz) or ceramic material that is *piezo-electric*. This kind of material is a natural transducer: If you connect a set of terminals to a small block of the crystal or ceramic material, you get a voltage when you squeeze or twist the block; alternatively, the block twists or changes shape if you put an external voltage across it. So it naturally changes mechanical movement into an electrical signal, or vice versa.

Piezo-electric materials have many uses. For example, Fig. 2 shows the idea behind a crystal phonograph cartridge. The needle is attached to a small block of crystal. As the needle rides in the record groove, it twists the crystal, and the two wires attached to the other end generate a voltage proportional to the needle movement. When sufficiently ruggedized, it also works backward. For example, some 40 years ago, Astatic created a recording head that used a crystal to make records. When fed with 50 or 100 volts of audio, the crystal would move a sharp needle and cut a record.

Although crystal cartridges are no longer popular, piezo-electric materials are still often used. One modern application is for lighting a gas flame. When you push a button, a small weight hits a piezo-electric block, which in turn generates several thousand volts. This causes a spark that lights the flame.

In the crystal or ceramic mike, the diaphragm is coupled to the piezo-electric material so that the sound vibrations move the block; this in turn generates an electric voltage that is proportional to the sound signal. The mike can generate a volt or so of audio, though only at a small current.

Crystal and ceramic mikes are somewhat fragile, but back in the days before inexpensive IC amplifiers were available, they were popular because their output didn't need much amplification to be useful. But today's integrated circuits provide lots of cheap gain, so the most popular contemporary mike is the dynamic microphone.

Dynamic mikes work on the same principle as electric generators in power plants or even in your car: When a coil of wire is placed in a changing magnetic field, the coil generates a voltage. This can be done in two ways—either keep the coil stationary and move a nearby magnet, or else keep the magnet stationary and move the coil.

Since the coil is usually lighter and smaller, it's more common to move the coil. In the dynamic mike, the diaphragm is attached to the coil, and the magnet is stationary. When the diaphragm vibrates, the coil moves in relation to the magnet, and thus produces a small voltage.

Dynamic mikes and dynamic earphones have much in common, since the earphone can work as a mike, and the mike can work as an earphone (except that the earphone usually isn't rugged enough to produce much sound). For instance, Fig. 3 shows the earphone from a typical telephone. In this case, an electric current through the coil (which is called the voice coil) produces motion. The *voice coil* is attached to a diaphragm that then vibrates and produces sound. Modern speakers have a similar construction, except that the diaphragm is much larger and is called the *cone*.

As I mentioned above, dynamic mikes and earphones work in both directions. For example, some years ago, after placing a call from a pay phone, I discovered that someone had apparently stolen the mike from the handset. By yelling into the earpiece, I was able to complete my call anyway. But since dynamic mikes (and earphones!) produce much less output than a carbon mike, even with yelling my signal was very hard to hear.

Dynamic mikes can produce very good sound quality, mainly because the mass of the diaphragm and attached coil is very small, and so they easily vibrate in step with the sound wave. Since the vibrations of sound occur very rapidly, a heavy diaphragm cannot move fast enough to accurately reproduce these sound waves. A carbon mike is worse, since it has to move a lot of carbon granules. A crystal or ceramic mike is better, but it still has to apply some force to the piezo-electric material and this increases the mass. A dynamic mike is an even greater improvement because the diaphragm and coil can be very light. The best mike would be one in which there is just a diaphragm, and nothing attached to it at all. There is a form of a dynamic mike, called a *ribbon microphone*, in which the diaphragm is actually a thin strip of foil acting as the coil. But these mikes are very fragile (a strong wind can ruin the foil) and also provide a tiny output, and so they are not very common.

Instead, professional recording studios often use an excellent (though very expensive) mike called a *condenser microphone*. In the condenser mike, the diaphragm acts as one plate of a capacitor. As it moves, the capacitance changes, and an amplifier picks up that change and converts it into a voltage change.

Condenser mikes require a power supply, partially to charge up the capacitor, and partially to power an amplifier right inside the mike. The amplifier is needed because the condenser mike output voltage is tiny, and so it has to be amplified right inside the mike before being sent out the cable. Professional recording studios usually have a 48-volt power supply inside the recording console to supply power to condenser mikes.

The cheap modern version of a condenser mike is the *electret microphone*. These mikes work on the same principle as older condenser mikes, but the diaphragm is made out of a permanently charged semiconductor material that does not need a separate power supply. There is still an amplifier inside the mike, but the amplifier needs only a volt or two to run and so can be powered by a single battery. Electret mikes are not as good as professional condenser mikes (since their diaphragms are heavier), but they are cheap and small. Radio Shack has some electret cartridges for $2; these cartridges are often found inside small cassette recorders. When you buy an actual electret mike, most of its cost is in the case and hardware, since the cartridge inside is often the same $2 cartridge (even cheaper in larger quantities).

light source. You can save a lot of time by looking at the light through a prism, which lets you see all the color components at the same time in the form of a rainbow or *spectrum.* The prism acts like a very large number of filters, all working together to check all the colors at the same time. You can then immediately spot whether a given color is in the light, or whether it is missing.

In communications there is an instrument that does the same job. Rather than looking at a signal through filters that look at just one frequency at a time, we can use a *spectrum analyzer* to break down a signal into its components and display them all on a scope screen as a *spectrum* (notice the similarity to the use of the word in referring to a spectrum of color).

The spectrum analyzer measures the frequency components in a signal and plots the voltage of each component against its frequency. For example, if you were to look at a pure 1,000-Hz sine wave on the analyzer, you'd get a picture like Fig. 11.

If you imagine that 0 Hz is on the left of the screen, and each division to the right represents 1,000 Hz, then the "blip" toward the left would be at 1,000 Hz, and (in this case) have a height of 7 divisions. (Ideally, the blip would be just a thin line, but on the spectrum analyzer it is spread out so it looks like a very tall but thin bell.)

Leaving the analyzer at the same setting, Fig. 12 shows the spectrum of a square wave. This time there is a big blip at 1 kHz (I added small numbers at the bottom of the figure to mark off kHz) indicating the fundamental, and progressively smaller blips at 3 kHz, 5 kHz, 7 kHz, and 9 kHz, showing some harmonics. If you examine Fig. 12 carefully,

Continued on page 77

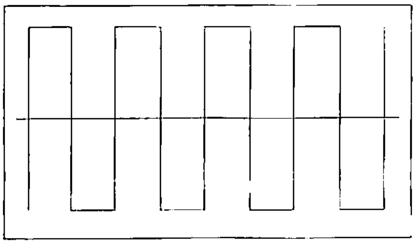

Fig. 8. A square wave.

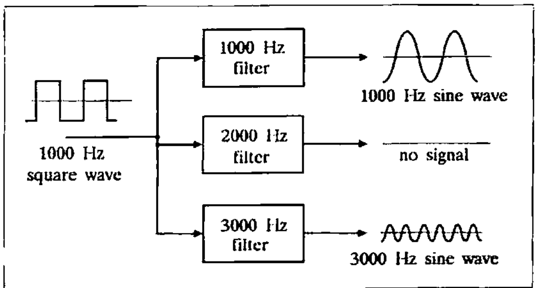

Fig. 9. Separating a square wave into components.

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NEVER SAY DIE

Continued from page 4

CompuServe, Prodigy, bulletin board systems, and so on?

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No, you don't know all the answers now, but with your ham background, at least you can understand the questions and you have some clues on where to find the answers. Knowledge is not only power these days, it's money. There are at least ten million small businesses that could be benefited by better communications, security, and computer systems. That's one heck of a market.

How long do you think it would take you to become an expert on pagers, just to pick one field at random? You need to get literature from the manufacturers, dealers, and service companies. You'd want to read a couple books on the subject, subscribe to a magazine. Are we talking six months? One month? A week?

Next you'd want to visit some of the companies involved in the business and talk with them. Find out their problems, what success stories they have, which equipment they think works best, and so on. Couple of months in your spare time?

Now that you have a good understanding of the technology, the players, and have the contacts you need, what should you do next? My recommendation would be to sit down at your computer and write a brief handbook on the subject—maybe 32 pages. Write it for the nontechnical average business person. Explain the benefits this service provides and show how the costs are small compared to the benefits. You can make the handbook look professional by printing it on a laser printer. The first hundred copies can be made on a copy machine. That's the way I do all of my booklets until the demand gets out of hand and practicality forces me to use a commercial print shop.

This will provide you with some sales literature for your new communications consulting service. With your name as the author, this certifies that you are an expert. It's like a Ph.D. Now you're in a position to send letters to local businesses offering the first phase of your communications consulting services.

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Within a year, if you make any kind of an effort at all, you'll be Mr. Communications in your town, and you'll have dozens of small businesses turning to you for solutions. In the communications business you make money on sales, on installations, and on service. Great business. All communications equipment breaks, so the service business is wonderful. And computers, being the most complicated of all, break the most often. Plus there are viri, incompatible software, static electricity, errant magnets, and so on, to help keep you living comfortably.

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Expert Help Needed

If you are already an expert on any phase of communications, how about writing an article for possible publication in *73* to help newcomers to the field? They need to know the suppliers, publications, have a list of recommended books, how distribution works, what frequencies and services are available and their average cost—things like that.

If we can get a series of articles to help *73* readers come up to speed on business communications services, that'll help a bunch of hams build some spare-time income, and maybe be able to take their new consulting businesses full time as entrepreneurs. So what's out there in BBS software? In security products and services? In video conferencing? Satellite services?

Or are you happy with your old ham gear and not having enough money to comfortably buy a subscription to *73?* Tsk. The money is out there in great big gobs, you just have to make a little effort to grab it. And that means turning off the ball games and doing some homework instead. Get off the couch, put down that can of beer, brush off the pretzel crumbs, and get cracking. I don't care if you're 20 or 70, you can learn new things and it'll be some of the best fun you've ever had. Heck, I'm 73 now and I'm tackling a whole new branch of physics—one which not even the best scientists in the world understand yet—cold fusion. Now *that's* exciting.

I'd love to know more about communications, so I'll be reading any articles submitted for my own edification and well as yours. That means they've got to be simple enough so I can understand them.

CW Fiends Alert

Just because I am anxious for us to build up our ranks before the FCC wises up and closes us down as no longer relevant, some code-loving readers have misinterpreted this as Wayne hating CW. Well, actually, I really do hate CW, but that has nothing whatever to do with my efforts to get the code test the hell out of the licensing exam system. No, the reason I have always hated the code is because my beloved government made it mandatory.

I have an obviously twisted gene which just naturally rebels against anything mandatory. I wouldn't have lasted long as a slave. Hmm, I wonder if the blacks may have a problem with the natural selection process working over several generations as slaves, thus tending to make them more inclined to be followers than leaders? Sure, call me racist, if that makes you feel superior. But it makes sense, and I haven't ever seen anyone come up with that concept before. And it could help explain a lot of what's been going on.

If the code had been voluntary, I'll bet I'd have been a whiz at it and had a ball. It's always looked like fun, but I'd be damned if I was going to be forced to do something. The Navy and I had some problems with this concept, with them being used to the "How high?" response to a command to jump.

Anyway, for those of you who have had no problem with knuckling under to the government, there's a great little CW magazine you've probably been missing. *Morsum Magnificat* is in its fourth year and is running around 48 pages a month. Subscriptions are $26.50 via airmail from the UK. Make checks out to Wise Owl, 4314 West 238th Street, Torrance CA 90505-4509. Credit cards via 310-375-6258. You'll love the stories and photos of old-time keys.

Once the FCC gets rid of the code tests I'll buy a key and start catching up on the fun I've missed. I might even organize code certificates which can be awarded at hamfests. I started my ineffective campaign to get rid of the code tests in 1958. Will I have made any headway when the 40th anniversary of my windmill tilt arrives? Probably not.

MARS News

Effective October '96, CW will no longer be used on any MARS circuits, according to a recent Department of Defense order. "It is recognized that CW can no longer compete with the rapid advancements in radio technology. Therefore, CW is to be retired from use within the DOD MARS." Newer modes such as packet, AMTOR, and PACTOR have also replaced RTTY.

Digital Camcorder

Digital video has been promised for some time. Well, it's finally arrived, via Panasonic. The camcorder provides 500 lines, which is 50% better than live TV broadcasts. It also records CD-quality audio, and all on a cassette which is 1/12th the size of a VHS cassette. Since the data is digital, it'll be able to connect to computers.

The cassettes use 6.35 mm tape and a 60-minute tape will store 12.5 gigabytes of information. That would take about 8,700 floppies, so this tape should have lots of computer applications for storage and backup. The 60-minute tape is expected to sell for about $14. The camera will be a little more, on the order of $4,000.

Will we someday be seeing ham rigs with a tiny digital camera built in? Only if the hobby doesn't get wiped out by the CW-forever mongers. Hey, would you like to see some video of me swimming with the turtles off the coast of Maui? Or how about the ham gathering on skis on top of Aspen Mountain? Or maybe our ham hunting safari in Africa? Or maybe my visit to the Taj Mahal with a group of Indian hams? Burma? Nepal? Navassa? News at eleven.

Okay, Who's the Quack?

The only ham doctor I can think of right now, the last I heard, is in prison for paying someone to kill his wife. But if there are any ham docs tuned in, I suggest you move on to my next topic and skip reading this. And that goes megadittos for anyone who is a True Believer in our beloved medical establishment. Yes, I've been reading some more books.

My work with a new model of the mind some 40 years ago got me interested in reading up on the various schools of psychiatry, psychoanalysis, and hypnotherapy. Using this model with some hypnotism I found I was able to quickly diagnose and

repair just about any kind of mental problems. And that was something no other approach to mind repair came even close to being able to do.

If you've read much of the literature you know that, in every careful test, none of the mental repair approaches are able to do any better than just giving people tranquilizers. The whole psychiatry business is smoke and mirrors, promoted to a gullible public as reality.

Okay, so I knew the psychologists and psychiatrists were humbugs, but I still had faith in medical doctors. This faith has been shaken recently as I've read more and more about alternatives to the establishment's use of drugs, radiation, and surgery to tackle the symptoms of illness. Doctors aren't even taught how to avoid illness in medical school.

Now I'm reading, *Immunization, The Reality Behind the Myth*, by Walene James, 285p, ISBN 0-89789-360-3. It's a very well researched book and it explains a lot about my own health. And probably, yours. You are so thoroughly inculcated by the media in the reality of vaccinations that you'd better read the book. I know you're not going to believe me when I encapsulate what it says. I really hate finding out that I've been a grade-A sucker all this time.

The bottom line is that not only don't vaccinations do any good, they're doing incalculable harm. The theory itself is baloney, and the billions of dollars doctors and pharmaceutical companies are making is nothing compared to the later costs resulting from the damage done. Yes, I know all about the diseases which mass vaccinations are supposed to have eliminated. So does the author. That's been a huge con job. Read the book

I was a healthy youngster until I had my first vaccination, which was required for me to enter school. Soon afterward I got sinus trouble, and for almost 10 years, and despite nose drops of Neo Silvol or Ephedrine several times a day, I was unable to breathe through my nose, even for minutes. When I was seven I suddenly developed massive allergies, to animals, foods, trees, pollens, dust, and so on. Hay fever, asthma, the works.

These are common results of the destruction to one's natural immunity system caused by vaccinations. Wait until you read the list of problems vaccinations cause! They kill a small percentage of kids outright. Doctors claim this is an acceptable loss, considering all the benefits resulting. Others suffer hyperactivity, autism, attention deficit, dyslexia, multiple sclerosis, cancer, leukemia, arthritis, diabetes, meningitis, tuberculosis, polio, smallpox, chicken pox, obesity, bulimia, thyroid damage, sexual disorders, etc.

Before the smallpox vaccine was discovered, there were almost no cases of smallpox in Japan. Then they instituted compulsory vaccinations. This resulted in 165,000 cases of smallpox, and 30,000 deaths. During the same period in Australia, where they did not have compulsory vaccinations, there were only three deaths. I'm not sure that's really enough to get anyone to think.

And how about cancer specialists in Canada, the US, and Britain who point to a definite link between the polio vaccine and cancer? By the way, the polio vaccine has killed far more children than the disease ever has unassisted by the vaccine. Oh, just read the book and see if it gets you to think.

I'd ascribed the change in family values to Dr. Spock's teaching the baby boomers not to discipline their children. But it could be that childhood vaccinations, plus later booster shots, are the real culprit. They have a tendency to make people more short-tempered and resistant to change. This could help explain our soaring divorce rate and ignored children. "Go watch TV and shut up."

As I've mentioned in my editorials, and in my book of WWII submarine adventures, the doctors came very close to killing me with a tetanus vaccine. It was only my own caution and firm resolve that saved my life. They were really pressuring me to have the shot, and it undoubtedly would have killed me. Thousands of people have died from vaccinations and hundreds of thousand gotten seriously sick.

If you knew that permanent illness or death was a distinct possibility for you or your children, would you voluntarily get those shots? Maybe you remember that last year's Miss America was deaf as a result of a childhood vaccination? Probably not. And I think her sister lost part of her hearing too.

Dr. William Douglass has a new book out claiming that the so-called Gulf War Syndrome is just the reaction to the barrage of shots all our combat troops were given before heading to the Middle East. The soldiers from the European countries did not get these shots and have not reported any of the resulting illnesses. The military does not make any tests before giving the shots, so it's no wonder they have deaths and a wide array of other bad reactions. And once your blood is poisoned by bypassing its defenses against these viruses and germs, you can't ever unpoison it.

There are endless reports of brain damage resulting from vaccinations, but not one report of brain enhancement. Yes, of course they are mandatory and the government will put you in prison if you refuse to have this poison injected into your body, or try to keep your children from being permanently poisoned.

But please don't believe me. Read the book and the overwhelming substantiation of every aspect of this, complete with the truth about all the lies used to force vaccinations on us. They don't work. They have not played any significant part in the reduction of any diseases anywhere in the world. They are a giant multi-billion dollar scam that is doing us all terrible damage.

Hey, maybe you can get your doctor to read the book. He's just as brainwashed about vaccinations as you are, in all probability. But then most dentists are by now aware of the serious damage putting amalgam fillings in your mouth can do to you, but they're still using 'em, and their patients are being slowly poisoned as a result.

Are Darwinians Wrong?

I watched a debate between a Darwinian Evolutionist and a Creationist on PBS the other night. The Creationist not only believed that the Bible's Genesis story is the truth, but that it should be taught in schools instead of the Darwinian theory of evolution: the survival of the fittest. The Scopes trial apparently didn't convince everyone.

The Creationists are upset because the Bible says man is built in the image of God, and the Evolutionists say, in essence, that he's descended from apes. Well, that isn't exactly what they say, but it's close enough. Actually, Evolutionists believe that man and apes are descended from a common ancestor. But one part of the evolution theory that really sticks in the Creationists' craw is the idea that evolution's mutation process is believed to be completely random and not divinely controlled.

It annoys me when scientists go about their business with blinders on. Blinders? Ask the next scientist you meet about ghosts. I have a great deal of trouble totally ignoring the sincere testimony of thousands, and even millions, of people who report things that are currently outside accepted scientific beliefs. Like what? How about ghosts, UFO reports, contactee stories, crop circles, precognition, reincarnation, past lives, near-death experiences, out-of-body experiences, psychokenisis, telepathy, psychometry, psychics, fortune-telling, the power of prayer, angels, poltergeists, voodoo, luck, synchronicity, serendipity, clairvoyance, and so on?

Sure, some of these may be 100% hooey, but where we have thousands of people all around the world reporting the same phenomenon, it's difficult for me to accept that every single one of them is either lying or crazy. Hey guys, maybe it's time to take off the blinders.

Tens of thousands of near-deathers have reported back on their visit to heaven and meeting with God. Isn't it odd that their reports are remarkably similar, no matter what religion they believed in before their experience? And, even odder, when they come back after being told that they have more to do in life, they are usually more religious, but no longer follow the religion they went in with. And they no longer have any fear of death.

They *do* believe in God, but they no longer consider themselves Catholic, Moslem., or any standard brand of Christian, and they're no longer sporting a "Honk if you love Jesus" bumper sticker. I'm not pushing any particular religion, or against any of 'em. I'm just telling you what you'll find if you read some books on the subject.

But that's a side issue which will undoubtedly have the overly-religious furious with me, just as are lawyers when I give facts about them, and ditto most doctors...at least the well-indoctrinated ones. And teachers. No, I don't condemn all of the above, knowing that there are exceptions to the rule. I've met Afro-Americans who don't hate Euro-Americans. I've met intelligent, progressive teachers. I've even met a few honest lawyers, and doctors who are actually open to at least consider alternatives to the usual drug and slash attack on symptoms, and never mind the causes of illness.

That long list of weirdness all comes under the heading of "life" for me. Life is quite separate from matter, though it has to use matter to deal with matter. I'll explain what I think matter is some other time.

Anyway, somewhere lost to history, the first DNA molecule was assembled. This was a molecule which could not only replicate itself endlessly, but also was able to modify itself as a result of the environment and keep that modification in memory. All known life depends on this molecule.

Dr. Fred Hoyle, in his book, *Evolution From Space*, estimated the odds against the DNA molecule being assembled by chance. He compared it to the chance that a tornado sweeping through a junkyard would assemble a complete 747. Well, it does seem odd to some scientists that nature hasn't come up with at least two basic life forms. Hoyle, by the way, is a world-renowned astronomer, so we're not dealing with a science-fiction writer off on a hare-brained crusade.

If you've done much homework in the occult field, you know that as people get in better touch with themselves they develop a feeling of oneness with all life. I've been there, done that, so I know how it feels. I'll tell you about that experience some time. I've put off writing about it because I don't want the Scientologists putting out a contract on me. I wish I was exaggerating.

Say, have you read *The Secret Life of Plants*, which I recommended? Or *Kinship of All Life?* Or *The Secret Life of Your Cells?* Do your homework so when we meet on 20m we'll have something interesting to

talk about...other than the model rig you're using.

Anyway, it seems reasonable to me that life, whatever it is, has a good deal of power to influence matter. We see it in luck, psychokinesis, and so on. So why shouldn't this life force also be able to modify evolution towards its own goals? If the original DNA didn't arrive from space a la Hoyle, perhaps it was the life force which assisted its original assembly?

Of course, if DNA did arrive from space, that just moves back the clock. DNA had to start somewhere, somewhen. And if earth is continually being peppered with DNA-based life forms from space, as Hoyle proposes, it does explain a lot of anomalies. Like why so many diseases suddenly spring up in a number of widely separated areas, all at the same time. And why so many new species have suddenly appeared in history without any apparent evolutionary bridges.

If "life" is influencing evolution, that might to some degree mollify the Creationists. It would certainly make life simpler for Evolutionists, who have a really tough time explaining the rapid evolution of specialized species of animals and plants adapting to new conditions. Shades of Lysenko!

So let's do our best to take off our blinders and be open to information which may not seem to be in line with our inculcated beliefs. The more you learn, the more I think you'll see how things start fitting together. All living things exhibit awareness, even CBers. Where we are different from animals and bugs is in our awareness of our awareness. Our drawback is a tendency to believe our senses. We believe what we see, so when some joker comes along and tries to convince us our senses are wrong, we kill him. Everyone can plainly see that the sun is going around the earth. And the stars, too. And the earth sure looks flat to me.

It comes as a shock to some when people find out that over 12,000 years ago astronomers worked out the circumference of the earth to within a 163 miles (they didn't allow quite enough for the bulge at the equator). And they even knew that the earth wobbled on its axis with a period of 26,000 years.

Copernicus and Galileo did not have an easy time convincing the scientists of their day that their beliefs and senses were wrong. So what's changed? The mental trip from believing that the earth was the center of all creation to understanding that it is a small planet in a relatively new solar system, out toward the edge of one of billions of solar systems in our galaxy...and that our galaxy is just one of billions of other galaxies, is a terrible downer. And where does God fit in this mind-bogglingly enormous universe? If you have an NDE and think to ask The Big Guy, please let me know when you get back.

Vanity Calls

The FCC is gradually phasing in vanity callsigns. They'll cost you $30 for a 10-year license. Cheap enough. When they get started, the FCC will be accepting applications (form 610-V) for the reissuance of calls you may have had in the past and lost, or the call of a deceased close relative. Hmm. I wonder if I should apply for W4NSD or W8NSD, or perhaps WR1AAB? Or K2PMM? I've had a bunch of calls down through the years, but I guess I'm stuck with W2NSD/1 until the Commission eases their restrictions so I can get "W."

Phase two will be open to Extra Class licensees. Then Advanced Class. And when that's all taken care of, any licensee will be able to invest $30 to get rid of KF4ZXZ, or some other awful combo.

The Candy Company used to issue the same suffix in a new area when you moved. That's how I got W4NSD, when I moved to North Carolina. And W8NSD, when I moved to Cleveland to work at WXEL-TV. By the time I moved to New Hampshire in 1962, the CC had stopped this generosity, so even though W1NSD was open and available, they wouldn't let me have it. They said they expected the rules to be changed soon, so just to operate portable and hold my water. I'm still holding 33 years later. I probably don't have the record for operating portable, but I'm right up there.

It's probably been months since I've told you about my operating in the Sweepstakes contest from Ohio in 1951 as W2NSD/8. Then, just as my W8NSD license came through, I moved back to New York, so I operated the second weekend of the contest as W8NSD/2. The only common piece of equipment was the microphone. Even so, I did well in the contest.

Someone else has been issued my 1958 license for Navassa, KC4AF, so I won't be able to get that one back. Drat!

The address for the vanity calls, once the FCC gets their computer programmed, is: FCC, Amateur Vanity, Box 358924, Pittsburgh PA 15251-5924.

Alchemy Today

If you know anything about chemistry at all you know that you can't turn lead into gold. Well, it seems that the old alchemists were a little further along than history has been leading us to believe. It wasn't lead, it was mercury that they were transmuting into gold, and the "philosopher's stone" they used to help the action was made of phosphorous. I know you're going to find this difficult to believe, but the Japanese have been doing a good bit of research on this more recently, and with considerable success.

My interest in the transmutation of elements began when I read the Bird-Tompkins 1976 book, *The Secret Life of Plants*. There was a chapter on how chickens are able to convert the potassium in mica into calcium for their eggshells. It almost got me to think. So I chased down Christopher Bird and got up to date on some of his newer books. His *Secrets of the Soil* is fantastic. It's a must read. I also got in touch with Cleve Backster, the chap who did much of the original work on communicating with plants. And he put me on to Brian O'Leary and *The Secret Life of Your Cells*, another fascinating book. But I've told you about those and you should have read 'em by now.

Chris suggested I look up the transmutation work by Michio Kushi. I found him and think you ought to know about his 1994 book, *The Philosopher's Stone*. Before you dismiss transmutation via biological processes as baloney you should at least look at the remarkable research data Kushi presents. He makes a very good case for the heavier elements on earth being made biologically from carbon, oxygen, and nitrogen instead of having to have originated from a supernova explosion, which is the current scientific dogma. It turns out that many scientists have researched this area with very positive results.

For instance, take $_{11}Na^{23} + {}_{8}O^{16} \rightarrow {}_{19}K^{39}$, for starters. Kushi put 2.3 mg of sodium in a vacuum, then ran an electric current through it until it was melted. Then he added 1.6 mg of oxygen. The result was 3.9 mg of potassium.

Then there is the data from Louis Kervran, who carefully checked the input and output of food and wastes from a group of men working in the Sahara in 1958. They generated far more magnesium output than input. Ditto potassium. More than could be accounted for in any way other than biological transmutation.

I think you'll enjoy the book, and it may almost get you to think. Or not. It's $10 (plus s/h) from One Peaceful World Press, Box 7 Becket MA 01223, ISBN 1-882984-07-2; 413-623-5741.

One of the reasons I got interested in transmutation is that the scientific establishment has been putting cold fusion down because it seems to involve the changing of hydrogen into helium, and "everybody knows" that alchemy died a deserved death a couple centuries ago.

Those Pesky ETs

Somehow, in amongst trying to keep up with the editing and production deadlines for two magazines a month (*73* and *Cold Fusion*), I also manage to read my mail and even answer some of it. For instance, I got a wonderfully chatty letter from Frank Thomas W4QDM. It didn't hurt when he started off saying how much he likes my editorials and the challenges I provide. He's been reading many of the books I've recommended and enjoying them.

Sure, I could just write about amateur radio, but my editorials are more like a monthly contact with you, where I talk not just about the hobby, but about anything else I think you might find interesting. And that's what you like about some of the ham contacts you make, isn't it? So get off the concept of everything printed being a lecture and get the idea of communication.

Anyway, Frank mentions that he's interviewed two people from Sylvania (GA) who had good close looks at a UFO which had landed in a field near town. One was a retired meteorologist from the Dept. of Commerce, and the other was the owner of radio station WSYL, so their credibility was high.

Unless you've been living in a cave with no radio or TV, you've seen and heard plenty of UFO stories. I've got stacks of UFO books—some are kooky, but many are well researched. The author of one was a good friend of mine, Jay Stanton. I've forgotten his ham call. When I first moved to New Hampshire he used to come up and visit. He went into the UFO book project as a skeptic, with the intent of exposing the whole business as baloney. He soon was convinced that most of the reports were real. Millions of people have seen UFOs and they're not all crazy. Thousands have reported being abducted, many repeatedly.

Another reader sent me a most interesting tape of David Jacobs talking about the real purpose behind the abductions. More *National Enquirer* stuff, right? Only if you don't do your homework. It's easy to dismiss something you don't know much about. Look at the fools some top scientists recently made of themselves in dismissing cold fusion. And we had the spectacle of the medical establishment trying for years to deny *H. pylori* as the cause of ulcers. And the ongoing power company fight against EMF dangers, the tobacco companies and cancer, and the ADA's fight to continue the use of dental amalgams despite all the scientific evidence of their destructiveness.

With the Big Bang theory now having been pretty well discredited, scientists admit they haven't any clue as to the age of the universe. This tends to make the possibility of there being alien visitors from more advanced civilizations much more likely. And then there's the possibility of time travel to further confuse things. We've enough reports of verified precognition to know that we still have a lot to learn about how time works.

I'll keep letting you know about the books I've found which I think you'll enjoy. When you come across a book you think I should read, please let me know.

Continued from page 71

you will see that the blip at 3 kHz is one-third the height of the fundamental at 1 kHz, and so on.

The presence of harmonics has an important effect on communications. Whenever we talk about sending a signal from one place to another, we have to make sure that all the components of that signal (or, at the very least, the *important* ones) get through as well. This brings us to the concept of bandwidth.

Bandwidth

Consider piano music. Obviously having a phonograph that covers the range from 27 Hz to about 4,200 Hz will let through all the notes, allowing us to recognize the melody.

But a restricted range like that does not sound like a very good piano. To make it sound realistic, you must let through all the harmonics—or at least the ones you can hear. That is why modern hi-fi equipment typically reproduces up to 20,000 Hz (or, at least, that's what

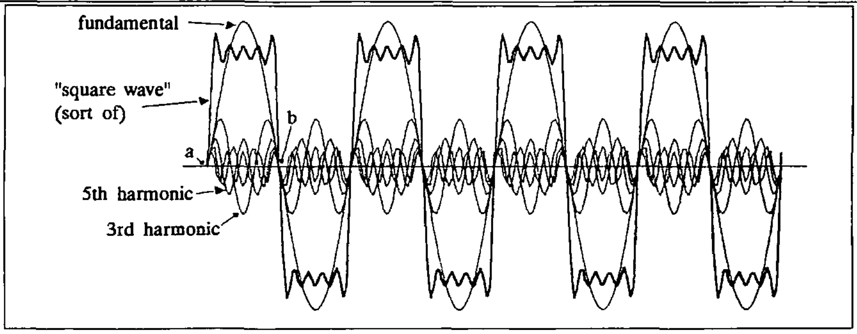


Fig. 10. Making a square wave out of a sine wave.

DETOUR

Detour 2

Let's talk about filters for a moment. Suppose you get several pieces of colored glass—one red, one green, one blue. When you look at a light bulb through the red glass, you see red light. Look through the green glass, and you see green light; look through the blue glass and you see blue light.

Don't think of the colored glass as a filter that is changing the white light into colored light. Instead, remember that white light consists of many colors, all combined together. The colored glass is simply a filter letting one color through, while stopping all the other colors. We can demonstrate that easily be putting the green and red glasses together and trying to look through both of them. When the white light goes through the red glass, only red light comes out. There is no green light left, and so when that red light hits the green filter, it is all stopped and nothing comes out (assuming that the filters are good enough).

If we have light from some unknown source, colored glass filters let us test that light to see what colors are in it. If we use a particular color glass, and nothing comes through it, then we know that that particular color was not generated by the unknown light source. But we can also interpret this result in a different way: if what comes out of the glass filter is different from what went in, then the original light must have had some colors in it that did not pass through the glass.

In the same way, electronic filters, like those in Figure 9, let us test an electrical signal to see what its components are. When we put a 1,000-Hz square wave into a 1,000-Hz filter, but a sine wave comes out, this tells us that the original square wave must have some other frequencies in it that cannot get through the filter.

the manufacturers claim!) In fact, 15,000 or even 10,000 Hz would probably do for us older people whose hearing no longer extends to 20,000 Hz (pity!)

Let's look at the frequency ranges covered by various pieces of equipment:

- •SSB transceiver—about 300–2,700 Hz.
- •Telephone line—about 300–3,500 Hz.
- •AM broadcast station—about 100–10,000 Hz.
- •FM broadcast station—about 50–15,000 Hz.
- • Compact disk—about 5–20,000 Hz.

Looking at these frequency ranges, we can clearly see which equipment will handle music best, and which is merely good enough for voice. (See Detour 3.)

So far, we've taken a short look at the nature of audio. We have seen that audio signals consist of frequencies in the range of about 20 Hz to about 20,000 Hz, but that a narrower bandwidth suffices if we're not too concerned with quality. For example, a typical telephone circuit can handle only the range of about 300 Hz to about 3,500 Hz.

A frequency range up to 3,000 Hz or 4,000 Hz is good enough to understand speech and even to recognize the voice of the speaker, but it is certainly not hi-fi. Let us now look where time comes into this.

Time

Say you have 20 minutes of things to tell him. You decide to record it on tape at a low speed. Then you rewind the tape and play it back, but at double the speed so that it takes only 10 minutes to play. Can you thus send 20 minutes of speech, but pay for only a 10-minute phone call?

You can certainly do that, but your voice will sound like the Chipmunks (that's how they do their voices!) and may not be too understandable. But suppose your friend records your voice on another tape recorder, but this time records at high speed and plays it back later at half-speed (try this with a Chipmunks record!) This stretches the 10 minute tape back into 20 minutes. Will this work? (And if it does, can you speed up the tape by a factor of 10 and pay for only a 2-minute call?)

Yes . . . and no. What happens is that as you double the speed of your tape, every frequency on the tape gets doubled too. A 1,000-Hz component of your voice becomes 2,000 Hz, and so on. The problem is that every component of your voice that is above 1,750 Hz or so gets doubled to above 3,500 Hz, and therefore doesn't make it through the phone line. In other words, your friend will only hear those components in your voice that are below 1,750 Hz. (And if you tried to speed things up by a factor of 10, he would only hear those parts of your voice that are below 350 Hz.)

In other words, it's the bandwidth of the telephone line that limits how much information you can get across in 10 minutes. If you used a higher-bandwidth line—such as the special lines that broadcast stations lease from the phone company for studio-to-transmitter links, which cover up to 10,000 or 15,000 Hz—you could easily speed up your tape by a factor of 3 or 5, and still transmit all of your message (though still only at normal telephone-line quality).

So the idea is that there is a tradeoff between bandwidth and time. If you have a fixed amount of information to send, you can send it fast if you have a lot of bandwidth. But you have to send it more slowly if the bandwidth is small. That explains why, for example, a fax transmission can go through a regular telephone line, but a full-motion TV video image can't. The fax takes up to a minute to send one picture, whereas the TV has to send it in 1/30 of a second.

Summary

Although the discussion has rambled off and on about various aspects of audio, we've actually covered a lot of ground. We have seen the characteristics that make up an audio wave—the frequency, wave shape, and amplitude of the signal. We have looked at how harmonics affect the wave shape, and how the bandwidth of a system affects the sound quality that you can send through it. Next time we will tackle transmission of video.

DETOUR

Detour 3

While we're on the subject of hi-fi equipment, let's discuss a few more terms.

It's not enough for a piece of hi-fi equipment to cover a wide range of frequencies; different frequencies in the range have to be treated equally. That is, an amplifier or tape deck that covers 20–20,000 Hz, but provides a lot less gain above, say, 1,000 Hz than below, would sound very bassy. Ideally, hi-fi equipment should be able to handle signals of different frequencies equally well. Evenness of response is usually rated in *decibels* or dB. For example, a typical amplifier might have a rating of "20–20,000 Hz ±1 dB," which means that the gain (how much it amplifies) does not vary more than plus or minus 1 decibel from some midscale value. (We'll have a detour later to explain decibels.)

In addition to having a wide frequency range, the hi-fi device also should not distort the signal. That is, its output waveform should look like the input waveform (except for possibly being larger or smaller). One way to rate distortion is as THD or *total harmonic distortion*. Remember that it's the harmonics that make one signal of a given frequency different from another signal of the same frequency. Hence if the output from an amplifier or recorder looks different from the input, its harmonics must somehow have been changed. The standard way of measuring this is to insert a pure sine wave test signal (that has no harmonics), and look to see whether there are any harmonics in the output. If so, then the signal got distorted. The THD number is a percentage that tells how much harmonic voltage got added to the pure signal. For instance, if the output from an amplifier (with a sine wave input that should have no harmonics) is 10 volts of fundamental and 2 volts of harmonics, then there would be 20% THD (a terribly high number, by the way. THD values of under one or two percent are more desirable).

Actually, though, harmonic distortion is not nearly as bad as you think. Since music and speech normally have harmonics anyway, adding an extra percent or so of harmonics to them is not too noticeable. Amplifiers and other all-electronic hi-fi equipment tend to have low distortion, but tape recorders and mechanical components such as phonograph cartridges and speakers often have a high THD (sometimes as much as 5% to 10% for speakers).

Much more dangerous is IM or *intermodulation distortion*, which introduces new frequencies not in the original at all. Even 1/2% or 1/4% IM distortion is grating and unpleasant. Unfortunately, IM distortion is not very often listed in spec sheets for equipment; fortunately, however, IM distortion sort of goes hand in hand with THD, and a hi-fi device with low THD *probably* also has low IM.

Finally, hi-fi equipment should have very little noise. Noise can appear in the form of a low-pitched hum (often caused by a bad power supply, bad grounding, or bad shielding of a wire) and a high-frequency hiss. Either one is bad. Hi-fi equipment specs therefore often list the SNR or *signal-to-noise ratio*. This is the ratio between the loudest music it can handle and the noise. For example, in a CD recording, the loudest music voltage is typically about 65,000 times higher than the noise voltage, while in a cassette recording it might only be 300 or 400 times stronger. In a telephone circuit, the ratio between the loudest voice signal and the noise might be as low as 10 to 1. Since we're holding off on our discussion of decibels, let me just say at this point that the 65,000 ratio is equivalent to about 95 dB, the ratio of 300 to 400 is about 50 dB, and a ratio of 10 is only about 20 dB.

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the May issue, we should receive it by February 29. Provide a clear, concise summary of the essential details about your Special Event.

JAN 13

HARRISBURG, PA The Harrisburg RAC will hold a Hamfest 8 AM-Noon at Oberlin FC Social Hall. For info. call (717) 232-6087; for table reservations, write *Tom Hall WU3X, Box 418 Halifax PA17032*. Talk-in on 146.76 and 146.52.

LOVELAND, CO The Northern Colorado ARC will sponsor the Winter Superfest at the Larimer County Fairgrounds, 700 S. Railroad. Talk-in on 144.515/.115 Pl 100 Hz; or 146.25/.85. VE Exams, tables, contact *Jeanene Gage N0YHY, (970) 351-7327. For general info, call Michael Robinson AA0UB, (970) 282-1167.*

PHOENIX, AZ The ARC of Arizona, hosted by ThunderBird ARC, will hold the West Valley Hamfest (WestFesT) at Glendale Comm. College, North lot, 6000 W. Olive (Dunlap & 59th Ave.). Contact *Morgan N7DLW, (602) 938-4356.* or *Mark N7KKQ, (602) 843-0960.*

JAN 13-14

SARASOTA, FL The Sarasota Hamfest and Computer Show will be held 9 AM-5 PM Sat.; 9 AM-3PM Sun. at the Robarts Sports Arena, Sarasota Fairgrounds, 3000 Ringling Blvd. Contact *Sam Everts KE4BXF, (941) 927-8999.* Talk-in will begin at 8 AM each day on 146.31/.91 and 444.925/449.925 Rptrs.

JAN 14

DOVER, OH The Tusco ARC Hamfest will be held at Ohio Nat'l. Guard Armory, 2800 No. Wooster Ave., starting at 8 AM. Setup at 6 AM. Contact *Howard Blind KD8KF, 6288 Echo Lake Rd. N.E., New Philadelphia OH 44663. Tel. (216) 364-5258.* Talk-in on 146.730(-).

JAN 20

GOWER, MO The 6th Annual Northwest Missouri Winter Hamfest will be held 9 AM-4 PM at the Ramada Inn in St. Joseph MO. Sponsors: Missouri Valley ARC, Green-Hills ARC, and Ray-Clay ARC. Commercial exhibitors welcome. Contact *Northwest Missouri Winter Hamfest, c/o Gaylen Pearson WB0W, 121- Midyett Rd., St. Joseph MO 64506.*

JAN 21

YONKERS, NY The Metro 70cm. Network will present a Giant Electronic Flea Market 9 AM-3 PM at Lincoln H.S. VE Exams. Indoor Flea Market. For registration, call *Otto Supliski WB2SLQ, (914) 969-1053.* Talk-in on 449.425 MHz Pl 156.7; 223.760 MHz Pl 67.0; 146.910 Hz; and 443.350 MHz Pl 156.7.

FEB 3

KNOXVILLE, TN The Shriners of Kerbela AR Service will sponsor the Kerbela Hamfest at the Kerbela Shrine Temple, 8 AM-4 PM. Setup Fri. 4 PM-9 PM; Sat. 5 AM-8 AM. FCC Exams by WCARS-VEC. Reg. until 9:30 AM. Mail completed 610 form with check for $6.05 payable to *WCARS-VEC, Ray Adams N4BAQ, 5833 Clinton Hwy., Suite 203, Knoxville TN 37912-2500. Tel. (423) 688-7771.*

ST. CATHERINES, ONT., CANADA The Niagara Peninsula ARC Big Event #18 will be held at the Canadian Auto Workers Hall, 124 Bunting Rd., 9 AM-2 PM. Setup at 7 AM. Contact *Marg Sewell VE3HOX, NPARC, P.O. Box 20036, Grantham Postal Outlet, St. Catharines ON L2M 7W7. Tel. (905) 680-1211.*

FEB 3-4

MIAMI, FL The 36th Annual Tropical Hamboree Amateur Radio and Computer Show will be held at Dade County Youth Fair and Expo Center, S.W. 112 Ave. & Coray Way. Sponsored by Dade Radio Club of Miami. Talk-in on 146.925. Booth and table info: call *(305) 642-4139;* or Fax *(305) 642-1648.*

SPECIAL EVENT STATIONS

JAN 20

SANDUSKY, OH The Sandusky Radio Experimental League will operate W8LBZ 1500Z-2400Z to celebrate the 100th Anniversary of the "Boy with the Boot" statue, Sandusky's official symbol. Operation will be in the General 40, 20, 15m bands, 146.655(-), and 444.375(+) Rptrs. For a certificate, send an SASE to *W8LBZ/SREL, 2909 W. Perkins Ave., Sandusky OH 44870.*

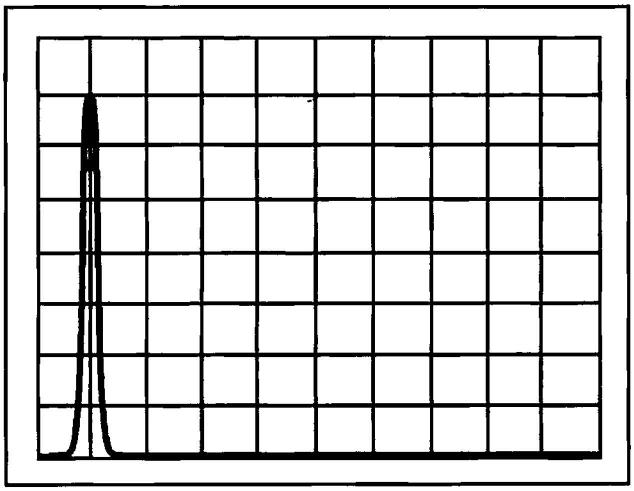


Fig. 11. Spectrum of a 1,000-Hz sine wave.

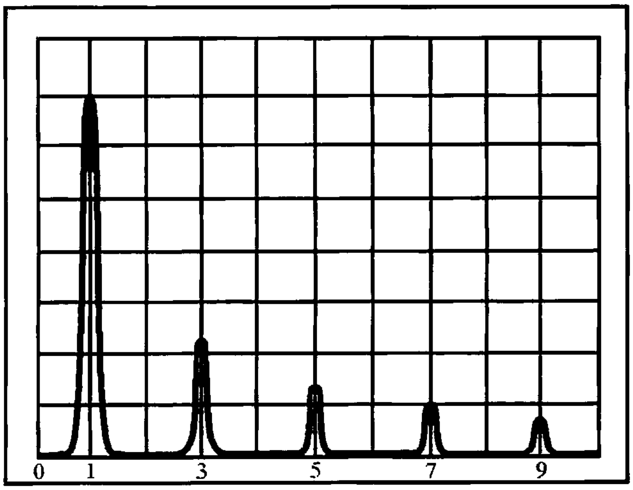
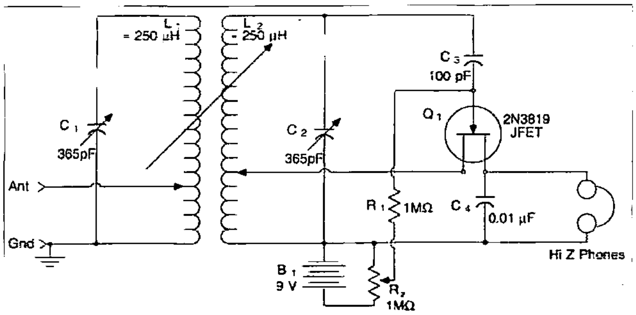


Fig. 12. Spectrum of a 1,000-Hz square wave.

UPDATES

In December's *73*, we ran David W. Cripes KC3ZQ's article, "Nostalgia for the Future," without the all-important schematic. Here it is:



The Ultimate Crystal Receiver

Letters
Continued from page 6

my license. In 1987, I re-tested and quickly acquired my General License again. Late in 1994, I passed the Advanced Class upgrade, and in August 1995 I upgraded to Extra Class. I have had to renew my high school memory of trigonometry, as well as learn how to use a scientific calculator. My main talent is sewing, not electronics, but I passed the test, three months short of being eligible for Medicare. And I understand that keeping the mind active wards off Alzheimer's disease and other maladies. I am very appreciative of the ham community, which has kept the bands active throughout the years in order that those of us who have been less active still have frequencies on which to operate. That means the old-timers. They probably have more stick-to-it-iveness than some of the newcomers. If they have not become bitter through the years, they have more manners than some of the younger generation. And manners speak well for amateur radio. And, off of that subject: May I suggest/request that it would be easier to respond to "Feedback" if the back side of the listing were an ad, rather than an article or printed circuit diagram?

Noted . . . Wayne

Jack Conway N5YIS I never go to hamfests, so I thought that I would never have an opportunity to hear you speak. When I read in *73* that you had a tape for sale, I just had to have one. Here is my five bucks: After reading years of good money-making ideas from you I thought I would send you two that you can have free of charge. Your offer to sell back issues of *73* was tempting, but like most people I don't have room for any more magazines. I do, however, have room for more CD-ROMs, so why don't you scan all your back issues onto CD ROM's and sell them? I know I would buy them just to read all the editorials. Why don't you put your audio publishing house to work putting together a Morse code CD? Reading the different magazine I read, I have always wondered why nobody put together a Morse code trainer on CD. Most CD players have a random play feature. I think it would be the best medium for practicing code. Keep cranking out the quality editorials.

Sure, I'll bet I could sell dozens of CD-ROMs of the back issues. Let me know if you'd like to scan in the 50,000 pages for me. Or maybe I could get some retired ham to scan in my over 1,000 editorials. I'll bet I could sell scores of those on a CD-ROM. We did a CD-ROM listing of every known CD back in 1989 and sold dozens of 'em. We even scanned in the color covers for hundreds of 'em, and had sample tracks of the music. It sold like cold cakes. The code? All it takes is one one-hour tape at 13 per to learn the code from scratch. And one at 20 wpm for that speed. Why would anyone put an hour of code on a CD when a tape does it just fine? . . . Wayne

Dave Kaun N9KMY It is truly time for our hobby to move into the new technology age. We need to substitute application of technical skills for Q&A manual memorization and the copying of the code as a method of advancement. Memorization, popular as a teaching method in previous generations, is no longer the way learning takes place today. While we expect our youngsters to understand and apply huge amounts of technical information, why are we still requiring memorization in amateur radio? Let's make our hobby a natural learning progression for technically literate students interested in what ham radio offers.

After many years of being involved with electronics as a hobby and as my career, I became a Technician before the no-code license was offered. To me the technical side of the hobby is much more important, though I would enjoy working HF if it were not for the artificial barrier the code presents. I find it quite interesting that many who once long ago learned the code can't carry their side of a technical conversation equal to the license they hold, nor even remember the code well enough to use it. More than memorization is needed today to understand technology: just ask any engineering student if formula or fact memorization is enough. Learning and understanding applications is much more important. We need to follow that same methodology of learning in amateur radio. Keep up the good work and the excellent magazine.

Philip Weaver VS6CT Wayne, it's been awhile since our paths crossed. I am leaving for the CRSA DX Convention in Beijing later today and was remembering how we met in the BY1PK Radio shack in Beijing back in 1984, when I was assisting with the communications associated with the Hong Kong-to-Beijing "555" Car Rally. I retired from the Hong Kong Government in February of this year and I have not stopped since. I will be dashing around Asia for the next two months, with visits to Bali, Thailand, Hainan Island on the South Coast of China, and Kota Kinabalu. I sold my flat here in Hong Kong and will be leaving for England in December to join the QE2 out of Southampton for a four-month round-the-world cruise. I am hoping that I will have managed to organize the setting up of a ham station on board and am awaiting word from Chip Margelli of Yaesu to supply me with a radio as the official sponsor of the station. I'll return to England in mid-April and expect to be back out here in Hong Kong in late May to try to find a flat where I can put some decent antennas on the roof. I am very bullish and optimistic about the future of Hong Kong, which is why I want to stay here, apart from the advantages of being somewhere that I know. I've enjoyed living here for 22 years. I just hope that my faith will be justified in the future. I still read your editorials with enjoyment, I just wish that they could produce more results. Keep at it Wayne.

Phil, I hope your trust of Beijing not ruining Hong Kong is justified. It's too bad the changeover isn't in 10 more years, after China has had an opportunity to adjust to capitalism . . . Wayne

Free Electricity
Continued from page 34

conditioning and refrigeration. A superefficient Sun Frost refrigerator will replace the old conventional unit when it dies. The Sun Frost unit retails for about $2,700. A 16-cubic-foot Sun Frost uses 32 amp/hrs. a day at 24 volts. That's about one tenth the amount of power the old refrigerator uses.

Chuck also has a landline BBS operating 24 hours a day with an Amiga computer as the heart of the system. He can save a lot of energy by converting to a laptop computer.

As I mentioned earlier, when the wires were being pulled through the underground conduit, several multi-conductor cables were also installed. These data lines will eventually be used to monitor system parameters such as array temperature, wind speed and direction.

Are there any 12-volt DC loads? Yes, and a Vanner battery equalizer allows a 12-volt battery bank to be charged from the main 24-volt battery bank.

Author's Note

I'll be happy to do a computer sizing for your repeater or hamshack. There's no charge for this, provided you send along several first class stamps for return postage. I'll need your name and the nearest large city with an airport having a weather station operated by the US government. I'll also need the system voltage of your load (12, 24, 48 volts), and an estimate of the amp/hr load you expect.

Barter 'N' Buy
Continued from page 72

Two meter SSB/Satellite Loops

A whole new world of fun lurks on the low end of 2M if you use the right antenna.

Gordon West WB6NOA
2414 College Drive
Costa Mesa CA 92626

The bottom end of the 2 meter band below 144.300 MHz is reserved exclusively for weak signal SSB and CW communications. No FM. Same thing between 145.800 MHz to 146.000 MHz—*no FM!* This area is reserved for weak signal satellite communications using SSB and CW. The term "weak signal" describes running 2 meter CW or single-sideband signals over great distances, well beyond normal FM 100-mile communication ranges. Weak signal modes like Morse Code (CW) and SSB (upper sideband) *cannot* coexist with FM transmissions because a nearby FM signal will literally cover up an ongoing SSB or CW QSO. So keep in mind that no FM is allowed below 144.300, and no FM between 145.800 to 146.000 MHz. Thanks for your cooperation!

Down below 144.300 MHz is where SSB communications span distances well beyond 100 miles. It's not uncommon for atmospheric tropospheric ducting to carry 2 meter SSB signals over thousands of miles, such as the path that occurred last summer between Nova Scotia and Florida. Last summer also saw the 2 meter SSB records shattered for the ultimate distance contact between Washington and Hawaii. The conditions lasted for several days!

Almost all communications on 2 meter SSB below 144.300 MHz use horizontal polarization, rather than vertical polarization. If you spot a beam antenna on a house that is mounted horizontal for 2 meters, chances are they're operating a 2 meter multi-mode SSB system. If you see a horizontally polarized antenna or a combination vertical and horizontal Yagi antenna pointed up toward the sky, this is probably a satellite set-up for 2 meter work. But there is probably one horizontal antenna that will really make you take a second look, and it is the 2 meter horizontal *loop* antenna.

"How about that 2m SSBNova Scotia to Florida contact last summer?"

This is what mobile units must use in order to obtain coverage, yet with a horizontal 2 meter pattern. The new popular ICOM 706 with 2 meter and 6 meter VHF capabilities in addition to high frequency capabilities will lead mobile operators over to a 2 meter horizontal antenna for work below 144.300 MHz.

A popular compact 2 meter square loop, called the "SQUOOP" is offered by M² Enterprises, Fresno, California (209-432-8873). The little 2 meter "SQUOOP" is housed within a black plastic cover, and offers unity gain omnidirectional coverage in an aerodynamic design that works well on any vehicle or mobile home as long as you get it well above the roof line. I have tested it against other loops, and its performance is O.K.

If size is not the object, consider the big cloverleaf horizontal loop that is a little bit more at home on your roof than on the roof of your vehicle. It's big, but all that metal really captures weak incoming horizontally polarized 2 meter waves. It's available from Laddy Reisinger N8EWU in Oceanside, California (619-722-8563. I found its performance slightly above the M² little loop, since all that metal captures a little more of the incoming horizontal signal.

Another Southern California ham, Norm Pedersen KB6KQ, Bellflower, California (310-925-0733)), has developed a "Mini Loop" that has a high performance for its small size and is easily stacked for a slight increase in weak signal capture capabilities. We recently tuned in Paul Lieb KH6HME, driving up the side of a volcano in Hawaii using a single Mini Loop, and his signal was making the 2,500-mile path extremely well. For the smallest loop with the greatest signal capture capabilities, this loop has it hands down. It's also a home-brew antenna offered to amateur operators on 2 meter SSB.

Another attention grabber is from the M² gang, a Mike Staal K6MYC special, Fresno, California (209-432-8873) is called the "Egg Beater." This can be used for both 2 meter horizontal SSB communications with terrific signal-grabbing capabilities, as well as right hand circular polarized mobile satellite work up at 145.800, too. The Egg Beater had best response to the Hawaiian 2 meter beacon when it was coming in just above the noise level. The Egg Beater did best, with the Mini Loop coming in a very close second, followed closely by the cloverleaf, followed relatively closely by the M² "SQUOOP." All of these antennas look out of place on a modern vehicle, but hey, that's the price to pay when you want to work 2 meter mobile SSB and regularly talk to other mobiles over distances beyond 100 miles. And we are not talking through repeaters, we are talking direct. The advantage of SSB simplex over FM simplex is double, triple, and sometimes quadruple greater on SSB than what you could do with wide and noisy FM.

I've also found many newcomers getting started with 2 meter SSB wanting something nice and compact. The gang at Cubex Quad Company rose to the challenge of a compact pre-assembled quad specifically tuned for the 2 meter band and operated either vertical for FM

or horizontal for 2 meter SSB. Cubex Company in Brea, California (714-577-9009) calls their little 4-element, pre-assembled, lightweight cubical quad the "Yellow Jacket," and everything comes pre-assembled where all you need to do is to poke the supplied fiberglass spreaders in through the holes on the boom, attach the pre-assembled and color-coded wire elements around the spreaders, run your coax, and sand off the ends of the spreader wire tips so they are nice and smooth in case someone should walk into your assembled quad antenna set-up. You know, safety first! The quad sells retail for under $40, and gives you a big boost in directional signal strength well above a simple ground plane home antenna or equal gain to a little 3-element Yagi. The quad also comes with its own mast and could serve as a wonderful direction-finding antenna, too. Everything is pre-assembled, so you don't have to do any measuring or anything—just follow the instructions, snap everything together, and presto, you are on the air with either vertical or horizontal polarization. For 2 meter SSB and CW, make sure you go horizontal and point the quad for best signal strength.

During extensive testing of omnidirectional mobile loops, all did a terrific job in pulling in extremely weak SSB signals, including the Hawaiian beacon thousands of miles away. But switching over to the quad and aiming it in the right direction definitely increased transmit and receive signal strength. Same thing in working the satellite.

You can also build these horizontal antennas yourself, like the gang in California has done for resale. But I recommend getting one already put together, tuned, and tested rather than trying to outdo what somebody has already spent years in design and testing. Learn from their hard work what it takes to make a good horizontal antenna even better through refinements. See whether or not bigger is always better, and check out some of the tuning techniques these experts have used to give you proper impedance matching and performance right where you need it on the weak signal portion of the bottom of the 2 meter band.

Number 85 on your Feedback card

RF Sniffer

Here's an ultra-simple piece of test equipment

J. Frank Brumbaugh KB4ZGC
Box 30
Salinas PR 00751

An old trick for sniffing out RF leaking around the shack can be useful in modern ham station installations. Any RF which does not reach the antenna is not only wasted power, it often can be the source of interference to radios, TV sets, telephones and other home electronics. The opposite is also true - if RF can get out, it can also get in - and RF from motors as well as household electrical and electronic equipment such as TV receivers, VCRs, etc. can raise the noise level in the ham receiver and otherwise interfere with station operation.

Old, surplus coaxial cable and some new coax is so poorly shielded it is little better than open wires. Coax which leaks RF should be replaced with high quality cable. Poor, leaky coax not only wastes RF which never reaches the antenna, it also can pick up interference over its entire length.

Gaps in shielding, especially in high power installations, and poorly soldered or loose RF connectors should also be corrected to eliminate leakage and possible interference.

The junk box solution to visual detection of stray RF is illustrated in **Fig. 1**.

Construction

Making the RF Sniffer is simple. A small diameter wood dowel, or a stiff wire cut from a coat hanger, about two fed long, has the NE-2 neon bulb and 120k Ohm resistor attached at one end with tape. The glass portion of the neon bulb must not be covered because it indicates the presence of RF.

A pair of wires connected to the neon bulb and resistor should be taped along the dowel or stiff wire, leading to the end where the 500k Ohm or one megohm potentiometer is taped or otherwise fastened. A piece of wood or plastic, or a long loop formed in the end of the coat hanger wire, can serve as a handle. The AC line cord is connected to the pot and the wire from the resistor at the handle end of the sniffer and all connections taped to prevent accidental contact.

Adjustment and Operation

Plug the sniffer into a source of 117 Vac. Observe the neon bulb while adjusting the pot. As resistance is decreased slowly, an orange glow will appear around one of the two electrodes in the neon bulb. A further decrease in resistance will result in the orange glow surrounding both electrodes.

Slowly back off the pot until the orange glow is again around only one electrode. Do not readjust the pot from this point!

Using the sniffer as a probe, with the transmitter producing power, investigate coax connectors and jumpers, coax runs, ac wiring in the shack or elsewhere in the house where RF is suspected, while observing the neon bulb.

When leaking RF is detected, the orange glow in the neon bulb will flicker and surround both electrodes.

If RF seems to be detected put the probe back and watch the neon bulb. If the glow retreats to surround only one electrode, RF leakage is present where detected. If, however, the orange glow continues to surround both electrodes, readjust the pot so it is visible around only one electrode and recheck for RF leakage. Because transients and other minor disturbances on the ac line are common, they can cause erroneous indications of detected RF when the sniffer is set at its most sensitive point.

Conclusion

This gadget is not frequency sensitive. It will work a well at UHF as it does at HF and even the TV horizontal oscillator frequency. It is extremely sensitive to low levels of RF. Best of all it is cheap, and can be put together from the usual junk box contents.

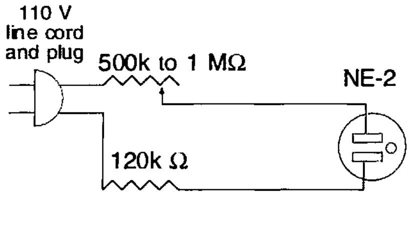


Fig. 1. How simple can you get?

Line Voltage Monitor

A one-hour construction project with a parts cost of under $5!

J. Frank Brumbaugh KB4ZGC
Box 30
Salinas PR 00751-0030

There are a number of 0-150-VAC meters available, but they're difficult to read when you're looking for small line voltage changes. A much more easily read meter is a suppressed-zero, expanded-scale meter which displays only voltages between 90 and 130 VAC. It can be read at a distance and at a glance so you can take action should your household voltage swing too high or too low. The simple circuit described here uses only five common components and can be constructed in less than an hour. The total cost, not including a box, should be less than five dollars.

Background

Power companies attempt to control both the level of AC voltage and frequency delivered to their customers. Though limits on both are established by regulations, some companies are better than others. However, as well all know, they have occasional problems which can possibly harm your equipment.

"Brownouts," common in urban areas in the US when air conditioners or electric heating systems require more power than anticipated, result in lower voltages being delivered to homes. Occasional overvoltages occur when power is switched from one substation to another, or to another point on the national power grid. Although nominal AC voltage in the US is 117 VAC, this can vary between 105 and 130 VAC, while remaining within specifications. Most household equipment is designed to tolerate excursions within this area. However, AC voltages lower and higher than these accepted limits can cause problems with your ham equipment.

AC line voltage can often fall as low as 90 VAC and stress AC operated motors such as cooling fans in amateur transceivers and RF amplifiers, damaging expensive power transistors and amplifier tubes.

High voltages, above 125 VAC, can burn out electric motors. Also, the increased peak voltages applied to filter capacitors, regulators, and transistors in power supplies, especially if the filter capacitors are already operating at or very near their rated working voltages can explode an electrolytic capacitor.

Such high voltages also increase the power dissipated as heat in the power supply transistors. This can cause extra heat at their junctions, causing them to fail, and thus applying a much higher unregulated DC output voltage to your station equipment. This can cause expensive damage.

How It Works

Fig. 1 is the circuit diagram. AC voltage applied through the line cord is halfwave rectified by D1 and applied to zener diode D2, which greatly reduces the peak voltage. Capacitor C1 acts as a poor filter and the partially filtered pulsating DC voltage is applied to meter M1 through meter multiplier trimpot R1. When calibrated, the AC line voltage is continually indicated on M1.

The value of C1 controls the voltage end limits. If you use a different meter, or wish a different voltage range, try different 150-volt capacitors in place of C1. Be sure C1 has at least a 150-volt rating. Its type is immaterial.

Construction and Calibration

The meter should be mounted in an enclosure to prevent any accidental contact with the AC voltage, which can be lethal. A plastic or metal box can be used. The few components can be mounted on a terminal strip. R1 is best attached to either the rear of the meter case or the interior of the enclosure, using epoxy, superglue or hot glue.

Look at your meter scale. With luck there will be four main divisions. If not, carefully take the meter apart and divide the meter scale into four equal, 10-volt divisions, using a fine tip felt pen. Mark these points 90, 100, 110, 120, 130. Reassemble the meter and mount it in its enclosure.

If you are unfamiliar with disassembling meters, please see my article, "Use Those Surplus Meters," *73 Amateur Radio Today,* January 1992, page 42. If you can't locate a copy locally, the publisher can supply back issues or article photocopies.

With your meter scale properly calibrated and all parts mounted in the enclosure, adjust R1 to maximum resistance. Using an accurate AC meter—a digital multimeter is preferred for accuracy, but a V-O-M can be used—measure the AC voltage at the nearest outlet, and note this value.

Plug in the Line Voltage Monitor. Being very careful not to touch any points carrying voltage, adjust R1 so the meter indicates the same voltage you measured previously. This completes calibration.

Operation is automatic. When this instrument is plugged into a live 117 VAC outlet it will continually monitor the level of voltage supplied by the power company.

Notes

Be sure the meter you use has a moving coil (D'Arsonval) movement. Do not use an iron vane meter. If you can't tell the difference at a glance, a good rule of thumb is: If it looks expensive, it probably is a D'Arsonval meter. If it is round or square and has a cheap-looking black painted metal case held together with bent metal tabs, it is probably an iron vane meter.

There are similar-looking line voltage meters commercially available costing

about $20. Some of these appear to use an iron vane meter. You can build a better monitor for a lot less money.

A major disadvantage of using an iron vane meter to which a voltage is applied continuously is that they lose accuracy as the movement becomes magnetized. You'll find that, if you unplug one after a year in use, the needle will not return to the left end of the scale. Instead, it will indicate some level of voltage even though none is being applied.

An excellent and inexpensive source of surplus name-brand meters with D'Arsonval movements is Fair Radio Sales, Box 1105, Lima, OH 45802. A selection of five meters (their choice, not yours), Catalog No. 47-84, costs $10. Mostly basic 0-1-mA movements will be in each selection. Usually there will be one, possibly two meters with 100-µA movements. Some may have internal shunts, multiplier resistors, or rectifiers, but these are easy to eliminate, leaving you with the desired basic meter movement. This gets you your meter for only $2, and you still have four more nice meters for future projects! 73

Parts List

C1	0.01-µF 150-volt capacitor,
D1	1N4007 rectifier diode
D2	1N4764A zener diode
M1	500-µA meter
R1	50-kΩ trimpot

QRX–Canada Adopts IARP

Continued from page 8

President Farrell Hopwood VE7RD, and IARU Region 2 Vice President Tom Atkins VE3CDM. *TNX Amateur Radio Newsline*

Austrian Licensed

The Republic of Austria will celebrate its 1000-year anniversary in 1996 and Austrian hams will be a part of the celebration. This with the government authorizing special call sign prefixes for radio amateurs.

At the request of the Austrian Amateur Radio Society, communication authorities will permit Austrian amateurs to use the prefix OEM for the entire year. Use of the prefixes will be voluntary and the national society will sponsor two on-the-air operating awards in conjunction with their use. *TNX Amateur Radio Newsline*

Instructor Of The Year

Nominations are open for ARRL Instructor of the Year awards, the ARRL Herb S. Brier Award, the ARRL Professional Educator of the Year, and the ARRL Professional Instructor of the Year. Send nominations to your league Section Manager by January 31, 1996. *TNX Amateur Radio Newsline*

Cuban VHF Group Activities

In DX, the Cuban VHF Group is planning some activities to say goodbye to the "old" 1995 and will activate some "new" grids around the country.

From November 22th to the 26th, the group will operate an IOTA DXpedition to "Cayo Jutia," in Grid NA93. This is a little key 2 miles away from the north coast of Cuba's most western province, Pinar del Rio. Operators will be from Italy, Spain, Portugal, France, Mexico, and Cuba.

Operation is planned for 6 meters, 2 meters, and 1,296 Mhz. Other bands will be added if gear becomes available for 220 Mhz and 70 cm. *TNX Amateur Radio Newsline*

Tropo DX

Ken Rameriz KP3XS in Puerto Rico says that the best Tropo event he has seen in a long time occurred the evening of October 30th and was still present at 1 AM EST on Tuesday the 31st. Ken says, via the Internet's VHF Reflector, that he took to the airwaves at 8:30 PM EST and found the band open to Florida. He then proceeded to work every Florida grid down to the Keys. The only grid missed was EL86.

Ken says that he kept hoping one of the Cubans would get on but no luck. He did hear one of the Florida stations work KD4UPF in FM18 and quickly swung the beams North East where his first contact was KM1X in Rhode Island! Ken then went on to work 90 stations in the next 4 hours including WZ2O all the way to 1.2 GHZ!

Talk about a night of unbelievable tropo DX. *TNX Amateur Radio Newsline*

DX S92po

Meantime on the high frequency bands, look for Principie Island on the air from November 21st to December 6th. A group of French operators will sign S92P on all bands on CW, SSB, and RTTY. They will also be active in the CQ World Wide DX CW Contest. QSL via F6KEQ. *TNX Amateur Radio Newsline*

Martian Trivia

A bit of ham radio television trivia via packet from Tim Ertl KE3HT. And this is really going to take you back a few years.

How many of you remember the 1960s TV series, *The Munsters?* No, not the recent movie seen on Fox but the actual black and white TV show that featured Yvonne De Carlo as Lilly and Fred Gwenne as Herman Munster.

Well, Tim says one episode had a ham radio connection. He describes the plot as Herman playing ham radio operator using the call sign W6XRL/4, calling CQ. Then, while tuning around he bumps in to a couple of kids playing as Martians and as usual, things get out of control.

So Herman enlists the help of Grandpa Munster played by Al Lewis. Grandpa has a Radio Direction finder of sorts. Well it's really a transistorized divining rod that they use to find the Martians who are nothing more than some neighborhood kids.

KE3HT adds that it is obvious that the episode was done in fun, but he will bet one of the shows writers was a ham. *TNX Amateur Radio Newsline* 73

Manufacturers, we would like to review your products and report on them in 73. Please contact Ron at 800-274-7373 for more details.

Letters

Continued from page 6

my license. In 1987, I re-tested and quickly acquired my General License again. Late in 1994, I passed the Advanced Class upgrade, and in August 1995 I upgraded to Extra Class. I have had to renew my high school memory of trigonometry, as well as learn how to use a scientific calculator. My main talent is sewing, not electronics, but I passed the test, three months short of being eligible for Medicare. And I understand that keeping the mind active wards off Alzheimer's disease and other maladies. I am very appreciative of the ham community, which has kept the bands active throughout the years in order that those of us who have been less active still have frequencies on which to operate. That means the old-timers. They probably have more stick-to-it-iveness than some of the newcomers. If they have not become bitter through the years, they have more manners than some of the younger generation. And manners speak well for amateur radio. And, off of that subject: May I suggest/request that it would be easier to respond to "Feedback" if the back side of the listing were an ad, rather than an article or printed circuit diagram?

Noted . . . Wayne 73

Number 88 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

January is seldom a good month for DX—or weather for that matter—and this month is no exception, so get ready for the bad news first.

There may be some very severe geo-physical conditions around the 15th or 16th and the 25th and 26th...give or take a day or two. Be prepared! The *best* days are likely to occur in the first, second, and last weeks of the month, while all else is trending.

However, the days are getting longer and you can expect the higher HF bands will be staying open longer. 80 and 160 meters will still provide excellent DX on the *best* days, and 40, 30, and 20 will do the same.

10–12 Meters

An occasional F2 opening toward the tropics during daylight hours...but, as is usual during sunspot minima, you can't expect much winter activity. Listen and call on the Good (G) or Very Good (VG) days.

15–17 Meters

Short-skip and some DX openings during daylight hours on Good (G) and Very Good (VG) days, particularly during afternoon hours. The band closes early, however.

EASTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15[1]	15[1]
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15[1]	15[1]
INDIA	20/40[1]					20[1]	40[1]	20[1]				15[1]
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40[1]	40[1]				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15[1]	20[1]	20[1]				40[1]	20[1]	20[1]			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	16	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R.	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*						20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40[1]	40[1]							15	15	20
U.S.S.R.		40[1]	40[1]	40[1]	40[1]				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

[1]Check next higher band
*80 Meters possible on good days only

JANUARY 1996

SUN	MON	TUE	WED	THU	FRI	SAT
	1 F	2 F-G	3 G-F	4 F	5 F	6 F-G
7 G	8 G	9 G	10 G-F	11 F-P	12 P	13 P
14 VP	15 VP	16 P	17 P-F	18 F	19 F-P	20 F-P
21 F-P	22 F-P	23 F-P	24 P	25 P	26 P	27 P-F
28 F-G	29 F-G	30 G	31 G			

20 Meters

Fair to good DX during daylight hours, peaking shortly after sunrise for an hour or so, and again in the early afternoon; and closing at, or shortly after, sunset. Short-skip up to 2,500 miles or so during daylight hours. Again, listen on the Good and Very Good days. Check WWV at 18 minutes after any hour.

30 Meters

A strange and unpredictable band! Sometimes like 40 and other times like 20. Your best bet for DX is late afternoon and early evening hours. Short-skip during daylight hours will prevail.

40 Meters

DX to Europe and Africa during late afternoon and toward South America after sunset. After midnight, listen for Asia and the Pacific. Short-skip during days and longer skip after dark.

80 Meters

This should be your best DX band during hours of darkness, peaking around midnight and just before dawn. Short-skip in daytime and longer skip after dark.

160 Meters

Here's another wintertime DX band. Open after sunset, and peaking to the *east* around midnight, and toward the west and Pacific areas near dawn. Band closes during daylight hours due to high absorption of these lower HF frequencies.

Please let me know how these forecasts are working for you. By the way, keep your fingers crossed because 1996 may spell the sunspot minimum of Cycle 22. We can hope, can't we? 73, Jim "XU" 73


73 Amateur Radio Today
USA
We Review
ICOM 706
Alinco DR-610T
Two Great Kits
N6IZW
You Can Build
RF Wattmeter
Packet Modem
VHF Test Equipment
0 74851 08725 1
02

THE TEAM

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM or Mac formats), carefully checked drawings and schematics, and the clearest, best focussed and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73® Amateur Radio Today

FEBRUARY 1996
ISSUE #425

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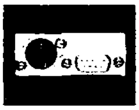
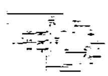
RADIO FUN SECTION

On the cover: Kerry N6IZW microwaving near Mt. Laguna CA to Mt. Union AZ. See story on page 20.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.



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Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

So Few Pages

There are so many interesting things to write about that I wish I had 20 pages a month. If I could stop myself from writing so much I'd look into setting up a web page. But the more I read and talk with the experts in many fields, the more I want to let you know what's going on.

This month I'll bring you up to date on the incredible developments in cold fusion. And my theory for why cold fusion is happening. I've got what seems to me the first rational explanation for why we have inertia and gravity. But then most people don't know that scientists don't know.

And I want to tell you about my drive around London on a magnet-powered scooter which defies the law of conservation of energy. And about my trip to Stonehenge.

I've some advice on how to build ham club attendance, and more news on ways we're slowly poisoning ourselves. This time its those pesky fluorides.

I've been doing a brisk business in my booklet of editorials written for *73* that haven't yet been published. It's running 32 pages of even smaller type than this, but I'll have to expand it to keep up with my output. Some of the material is ham-oriented. There are 46 of my editorials in the $5 booklet, but it'll probably be up to 60 by the time you read this — if the mail from that W6OBB radio talk show interview I'll be telling you about ever slacks off!

Cold Fusion Update

It's been quite some time since I've written about what's been happening in the cold fusion field. It has not been standing still.

For those with short memories for trivia, the cold fusion phenomenon was announced by Professors Pons and Fleischmann of the University of Utah in 1989. They claimed that by passing a small amount of current through a palladium cathode in a lithium and deuterium electrolyte they had produced a substantial amount of excess heat for which there was no good chemical or physical explanation.

"Yep, one thousand times more output than input!"

Several universities tried to replicate the experiment. Most failed, triggering a media stampede ridiculing Pons and Fleischmann. The U of Utah canceled their funding and dumped them. What wasn't made public was that many of the universities which "failed" to confirm the cold fusion process were getting generous funds for hot fusion research. If cold fusion was really true, the schools involved stood to lose millions. Also hushed up were the reports from several universities confirming the P&F results.

The controversy pretty well stopped the funding for American cold fusion research. Scientists in other countries, with Japan leading, continued to pursue the idea, getting substantial government funding for their work.

In late 1993 I became convinced that despite the media reports, cold fusion was not just a fact, but looked like it would eventually be able to supply energy at a fraction of the cost of fossil fuels such as coal and oil, and without the pollution these sources generate. With known fossil resources dwindling, this new energy source was coming along at the right time. But how would the world change if energy could be generated at a tenth or less the cost of energy today? Imagine cars requiring almost no fuel. Planes. Ships. Space ships.

So I attended the Fourth International Conference on Cold Fusion (ICCF-4) on Maui in December 1993, where I announced I would be starting a magazine to help researchers communicate, to provide a forum for physicists to argue over the theory of what was going on, to help newcomers to the field come up to speed, and to allow potential investors to find the ground floor scientists to support.

The field was alive and well during 1995, with international conferences being held in Boston (MIT), Monaco (ICCF-5), Bombay, Tokyo, Molise (Italy), and Sochi (Russia).

The leading light in the US is Dr. Jim Patterson of Sarasota, an inventor who got patents on his innovative cold fusion cell. He made microspheres of plastic and coated them only microns thick with palladium. The result was that his cells were able to start generating excess heat in minutes instead of days to weeks, as required by the use of solid palladium. He demonstrated his cell at Monaco, with the cell and instrumentation out in the open for everyone to check. His cell was generating about six times more energy out than it took to trigger it. And he was using plain water instead of the much more expensive deuterium!

Six months later, at a fusion conference at the University of Illinois, his demonstration cell was turning out 100 times more energy than required to run it! This was confirmed by the scientists from 35 countries attending the conference.

Two months later, in December 1995, the Patterson Patented Cell (PPC) was demonstrated at the Power Gen conference in Anaheim, where the top brass from power companies all around the world saw Jim's cell perking away, with one watt of power going in and 1,000 watts of heat being generated as a result. Yep, one thousand times more output than input! Let's see the cold fusion critics attribute that to errors in measurement. Jim's company is Clean Energy Technology Inc. (CETI). How'd you like to have a piece of *that* action?

Yes, the utility bigwigs sure paid attention. Several major companies are dickering with CETI for licenses to develop power systems using the Patterson technology. And CETI will get a piece of the action on any developments of their basic system. Early investors could reap billions from a fairly modest investment. The readers of my *Cold Fusion* were alerted so they could get in on the ground floor of this one, with the full information on the PPC in issue #7, back in March 1995.

Of course it's going to be years before we no longer need power lines, are running around with cold fusion powered wrist communicators, and so on.

The Heat Source?

The standard model for the atom and classical physics doesn't explain what's happening. This is one reason the scientific establishment pooh-poohed the P&F claims, humiliating them. So when a division of Toyota came along and offered to build them the laboratory of their dreams anywhere in the world, they ended up on the French Riviera. And Toyota ended up with a good chance at having the first car needing no fuel. We'll see. P&F are now being very secretive about their progress. That could be because they aren't making much progress, or because they are.

I've run a series of articles in *Cold Fusion* by some top scientists on what they think is going on. My own theory is that the excess heat is the result of a transmutation of elements in the palladium metal's lattice. Yep, alchemy. This would explain why there's some helium being generated, but not enough to explain the amount of excess heat. The universities of Illinois and Missouri are checking the Patterson cells to see if there are any other transmutation products. I predict they'll find beryllium, which will be a product of hydrogen and lithium, and some silver resulting from the transmutation of palladium and hydrogen. These reactions would easily account for the excess heat being generated, as well as the lack of radioactive products. This is cold fusion, working from the lower end of the periodic table, not cold fission, working from the top down.

The reaction is kept gradual since it is happening in the metal lattice. A fast reaction could be explosive, and we've seen some signs of that potential, with some lab experiments blowing up. One killed a scientist who was in the wrong place at the wrong time.

Inertia and Gravity

What *is* matter? Well, it's energy of some sort. We really don't know what matter is (yet), but like quality, we know it when we see it.

The cold fusion reaction has called into question the so-called standard model of the atom. A lot of verities are being called into question these days, despite the ear-plugs

Continued on page 74

LETTERS

From the Ham Shack

Jack Conway N5YIS. I never go to hamfests, so I thought that I would never have an opportunity to hear you speak. When I read in *73* that you had a tape for sale, I just had to have one. Here is my five bucks: After reading years of good money-making ideas from you I thought I would send you two that you can have free of charge. Your offer to sell back issues of *73* was tempting, but like most people I don't have room for any more magazines. I do, however, have room for more CD-ROMs, so why don't you scan all your back issues onto CD ROM's and sell them? I know I would buy them just to read all the editorials. Why don't you put your audio publishing house to work putting together a Morse code CD? Reading the different magazine I read, I have always wondered why nobody put together a Morse code trainer on CD. Most CD players have a random play feature. I think it would be the best medium for practicing code. Keep cranking out the quality editorials.

Sure, I'll bet I could sell dozens of CD-ROMs of the back issues. Let me know if you'd like to scan in the 50,000 pages for me. Or maybe I could get some retired ham to scan in my over 1,000 editorials. I'll bet I could sell scores of those on a CD-ROM. We did a CD-ROM listing of every known CD back in 1989 and sold dozens of 'em. We even scanned in the color covers for hundreds of 'em, and had sample tracks of the music. It sold like cold cakes. The code? All it takes is one one-hour tape at 13 per to learn the code from scratch. And one at 20 wpm for that speed. Why would anyone put an hour of code on a CD when a tape does it just fine? . . . Wayne)

Dave Kaun N9KMY. It is truly time for our hobby to move into the new technology age. We need to substitute application of technical skills for Q&A manual memorization and the copying of the code as a method of advancement. Memorization, popular as a teaching method in previous generations, is no longer the way learning takes place today. While we expect our youngsters to understand and apply huge amounts of technical information, why are we still requiring memorization in amateur radio? Let's make our hobby a natural learning progression for technically literate students interested in what ham radio offers.

After many years of being involved with electronics as a hobby and as my career, I became a Technician before the no-code license was offered. To me the technical side of the hobby is much more important, though I would enjoy working HF if it were not for the artificial barrier the code presents. I find it quite interesting that many who once long ago learned the code can't carry their side of a technical conversation equal to the license they hold nor even remember the code well enough to use it. More than memorization is needed today to understand technology; just ask any engineering student if formula or fact memorization is enough. Learning and understanding applications is much more important. We need to follow that same methodology of learning in amateur radio. Keep up the good work and the excellent magazine.

Philip Weaver VS6CT. Wayne, it's been awhile since our paths crossed. I am leaving for the CRSA DX Convention in Beijing later today and was remembering how we met in the BY1PK Radio shack in Beijing back in 1984, when I was assisting with the communications associated with the Hong Kong-to-Beijing "555" Car Rally. I retired from the Hong Kong Government in February of this year and I have not stopped since. I will be dashing around Asia for the next two months, with visits to Bali, Thailand, Hainan Island on the South Coast of China, and Kota Kinabalu. I sold my flat here in Hong Kong and will be leaving for England in December to join the QE2 out of Southampton for a four-month round-the-world cruise. I am hoping that I will have managed to organize the setting up of a ham station on board and am awaiting word from Chip Margelli of Yaesu to supply me with a radio as the official sponsor of the station. I'll return to England in mid-April and expect to be back out here in Hong Kong in late May to try to find a flat where I can put some decent antennas on the roof. I am very bullish and optimistic about the future of Hong Kong, which is why I want to stay here, apart from the advantages of being somewhere that I know. I've enjoyed living here for 22 years. I just hope that my faith will be justified in the future. I still read your editorials with enjoyment, I just wish that they could produce more results. Keep at it Wayne.

Phil, I hope your trust of Beijing not ruining Hong Kong is justified. It's too bad the changeover isn't in 10 more years, after China has had an opportunity to adjust to capitalism. . . Wayne)

Sharon Cenna KB8VXL. I just finished reading your September editorial. You have a lot of valid comments. You ask why ham radio isn't growing and why so few hams read the magazines. Well, I'm a new ham and I've found very few hams willing to Elmer (or Elmira). No one is volunteering to give demonstrations or workshops at the local schools or clubs. Even giving a demo on a parent/teacher night could be fun and enlightening. As for community service, CB usually provides help faster than 2m. All this prevents young people from learning about amateur radio. Have you heard of any ham groups anywhere in the country teaching kids how to come up with their own electronic inventions, techniques, or computer connections? I guess the only person I can change is me, so I better get going doing something creative in my own square of dirt, then share it with the next person I meet, and keep going.

I keep scanning the club newsletters, hoping to see some signs of responsibility for growing our hobby, as you've suggested. Nope, they're all busy having fun. No school or local club demos. Now and then a group will put on a demo at a shopping mall, but those that I've visited were very visitor unfriendly. Sure, the hams were having fun, but they made no effort to communicate this to visitors. I've talked with school kids in many schools about the fun we have to offer. I've talked to over a hundred service clubs about it all over New Hampshire and Massachusetts. But I feel I'm waging a one-man fight, with no visible support. . . . Wayne

Glenn Hammond Sr K4YDG. I have been a loyal *73* reader since the first issue came out in 1960. I was 12 years old at the time and earned the money to buy the magazines with my morning paper route. I also read *6-Up*, your VHF magazine, until it ceased publication. You made enough of an impression on me that I earned my Novice ticket in 1960 and steadily became more interested in electronics. During the Vietnam War

Continued on page 31

QSL Contest Winner!

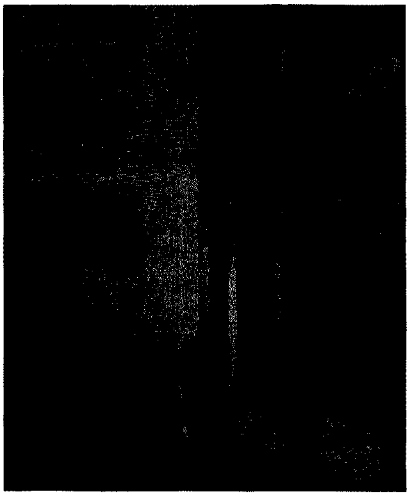
Page Perrin KG6JY combines two of his hobbies in this QSL. Page says, "By combining my two favorite hobbies, amateur radio and hang gliding, I'm able to have much safer and enjoyable flights. Air-to-air communications with other ham-licensed pilots about lifting air conditions, and air-to-ground contact for critical wind information just prior to landing make me glad I became a ham. Packet GPS will allow hang gliding pilots to fly cross-country and automatically report their position to their chase vehicle, or in an emergency to rescuers. Staying up for hours and flying hundreds of miles has become commonplace in the sport. That's Mt. Shasta in Northern California behind me. It is about 80 miles away."

QRX . . .

Number 8 on your Feedback card

ITU Nixes Code Change

New Zealand proposed the deletion of the Morse code requirement from the ITU amateur radio regulations, but the move was opposed by the American delegation, which was notable for the number of ARRL members on the delegation. The matter has been tabled until some future ITU conference. The success of the ARRL in preventing this move was expected, since it has rather tight control over the International Amateur Radio Union (IARU). But a growing number of countries would like to have the ITU amateur regulations more in tune with today's technology and not continue as a monument to the long past.



Nine-year-old Brian Kearns KC7MLW operating the CARL station.

Science Center Ham Exhibit

The Center for Amateur Radio Learning (CARL) successfully finished its first summer at the Arizona Science Center. The exhibit was located within the Tech-zone at ASC. The station featured an HF installation with a triband beam and a VHF packet station. With the help of over 40 volunteers from the Arizona amateur radio community who volunteered their time, visitors were able to speak with hams around the world.

The next CARL goal is to set up a permanent station at ASC's new facility, which is scheduled to open early 1997. The station will be state-of-the-art and will employ as many modes of amateur radio operation as possible, including satellite, HF, packet and ATV. Along with the station there will be an area set aside for visitors to build electronic projects such as crystal radio sets.

CARL is in the Arizona Science Center, which is dedicated to exposing children and adults to science and technology in a friendly hands-on manner. Approximately 500,000 visitors pass through ASC each year, with over being children. Technology has become an essential part of our society and exposing children to radio communications and electronics can lead to a lifelong interest In science. This is an opportunity not only to recruit new amateur radio operators, but also a project which can lead young people to careers in high-tech fields.

CARL is seeking help in raising the $50,000 needed to complete the project. Barry Goldwater K7UGA and Lou Grubb WA7HZO have offered their names and support for the project. Donations to the project are tax-deductible, and donated radio equipment may either be used at the station or sold for proceeds. If you would like to help please call Ralph Barr W0DNO at (602) 582-8208. In the Phoenix area join their net every Tuesday at 8:00 p.m. on 145.35 MHz, via the DAWN repeater. *TNX Rick Horwitz AB7FH.*

Hooray Oregon!

Features with young hams are what we need in every newspaper in the country. Congratulations to the hams in Oregon for getting this priceless PR in *The Oregonian.* The article points out how much fun the youngsters are having with inexpensive equipment, while learning about electronics and making new friends. Thanks to Steve Brose WA7EZB for sending the clipping.


RADIO-ACTIVE TEENS

Ham Towers Legalized!

Well, at least in Massachusetts. Governor Weld signed H-2782 into law. It states that, "No zoning ordinance or by-law shall prohibit the construction or use of an antenna structure by a federally licensed amateur radio operator. Zoning ordinances and by-laws may reasonably regulate the location and height of such antenna structures for the purposes of health, safety, or aesthetics; provided, however, that such ordinances and by-laws reasonably allow for sufficient height for such antenna structures so as to effectively accomodate amateur radio communications by federally licensed amateur radio operators and constitute the minimum practical regulation necessary to accomplish the legitimate purposes of the city or town enacting such ordinance of by-law."

Don't just sit there nodding in agreement, get your legislature to enact a similar law to help back up the FCC's PRB-1.

Updates

In the November 1995 issue, page 20, "A Simple Wattmeter." Yes, the diodes D1 and D2 are drawn backwards. The author had 'em wrong and it didn't get caught until a reader spotted it.

In my November editorial, page 74, I gave the phone number for Marcus Books. Since then the prefix has changed from 416 to 905. You can order *Maximize Immunity*, and other Marcus books, via 905-478-2201. Good luck on finding anyone there to answer. But you really should read the immunity book for your and your family's health, no matter...Wayne.

Feedback

In our continuing effort to present the best in amateur radio features and columns, we recognize the need to go directly to the source—you, the reader. Articles and columns are assigned feedback numbers which appear at the top of each article/column's title page. On your QSL card (or a regular postal card or letter), please write the number of the article or column about which you are critiquing and include the cover date of the magazine. Make it simple, indicate: Great, OK, or No Way. And let us know what you want to see more of or less of. If you want to write something at length, that's okay too. You may critique as many articles or columns as you want, but please only mention one article or column per card.

Do we really read the feedback cards? You bet! The results are tabulated each month, and the editors take a good, hard look at what you do and don't like.

Each month we'll draw a card at random. If yours is picked, you'll receive a one-year subscription (or extension) to 73. If you use your QSL card for your critique, we'll consider it also part of our QSL contest.

To save on postage why not send your card in an envelope with a damning or praising letter to the editor while you're at it too.

Send to "Feedback" at 73 Magazine, 70 Route 202 North, Peterborough, NH 03458.

Satellites, Weather Imagery, and Sunrayce '95

There's an Indiana Jones in each of us.

James R. Buchanan K8WPI
9549 N. 17th St.
Kalamazoo MI 49004

Anyone can have an adventure. All you need is a little willingness and a special skill or two. Then, be ready when fate drops an opportunity on you.

Winter 1987: The Seed Is Planted

The north winter wind was covering the woodpile with snow as I slogged back to the house with another load of logs for the fire. Entering the house and shedding a dozen layers of clothes, I opened the door to the wood stove to feed the flames of warmth. As the fire glowed through the glass door of the stove, the image on the TV screen was almost as bright. Minuscule cars, not much more than oversized skateboards, powered only by the sun, were winding their way across Australia from Darwin to Adelaide. A PBS special on the first World Solar Challenge caught my attention. I sat there spellbound for the next hour. This was the adventure of a lifetime. Twentieth-century Magellans, Byrds and Huck Finns were embarking on a technological revolution while sharing an adventure that dreams are made of.

The first World Solar Challenge caught my attention with a passion. I knew then that if I ever had the opportunity to become involved with such an event, I would jump at the chance, whatever the cost or consequences might be.

Fall 1992: Germination

The September meeting of the Kalamazoo Amateur Radio Club started with the obligatory business meeting, laden with the excitement of the August minutes and the treasurer's report. As the evening droned on, I began to fade from focus when I thought I saw Rod Sterling stand up at the chairman's table. A familiar voice announced that Western Michigan University was looking for a communication specialist, and was interested in investigating weather reconnaissance for Sunrayce '93 next summer. What? Was this the chance for me to don Indy's fedora and head off into the sunset in search of the solar grail? It took about two nanoseconds to know this was what I was looking for. I would make the commitment for myself and my wife, right there on the spot. I approached Rod (actually J. C. Schneider KF8TJ, a neighbor of Dick Schubert, the father of WMU's solar racing project) and advised him to have the WMU folks get in touch with me; I'd see their needs were met!

I spent the fall and winter of '92 reading every book written on anything related to watching the Earth from space and weather services in the RF spectrum. I started planning the ultimate mobile weather reconnaissance vehicle. By June, I was on the road with the most sophisticated, privately owned original-source solar reconnaissance vehicle on earth, as far as I knew.

Bearing Fruit

After successfully completing Sunrayce '93 from Dallas to Minneapolis with WMU, I was approached by a dozen hopeful schools about providing similar weather imagery and data for Sunrayce '95.

Sunrayce is a biennial event hosted by the Department of Energy, General Motors, National Renewable Energy Lab, and a dozen other automotive-related industries. The concept is to promote the technologies and growth of solar power. Universities, colleges, technical schools, and even community colleges from the US, Canada, Mexico, and Puerto Rico design, build, and race solar-powered vehicles across the country. The cars must meet minimum highway safety standards. Battery storage and solar collector maximum specifications are set by the race committee. The cars must be powered 100% from the sun. Excess energy collected from the solar array may be stored in batteries for use at a later time. For the most part, the race course is primary and secondary highways; little time is spent on the expressways.

There is a charging period each morning, this year from 6:00 a.m. to race start at 10:00 a.m. local time. The cars leave the starting line in the order of finishing the previous day's run, or in their qualifying position the first day. Cars are started in one-minute intervals, to spread them out over the course a bit. A mandatory midday stop provides the opportunity to change drivers, make minor

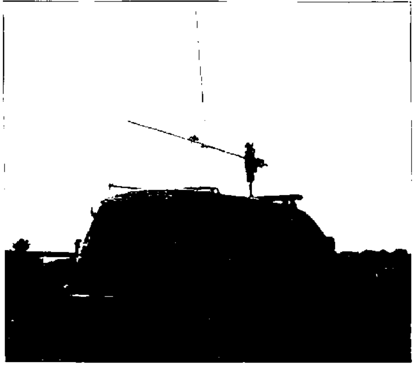


Photo A. "MONDO-MITSU" mobile antenna farm, Fort Smith, KS.

repairs, and to make a personal pit stop. This 15-minute stop is "off the clock," so all cars leave the midday stop in the order they arrived. A common end of day location is the finish line for each day. Charging is allowed until 9:00 p.m., when the cars are impounded overnight. The lowest elapsed time for the day's route establishes the day's winner, with the overall race winner being the team with the lowest accumulated time over the course of the race. This year's race was from Indianapolis, Indiana, to Golden, Colorado, just over 1,100 miles.

Each team has a lead and chase vehicle, and the solar car is "cradled" between these two buffers. With at least a three-car entourage for each car, passing can be a real challenge, but safety is paramount. Solar cars, with electrical consumption of less than a blow dryer, are fairly fragile. A broadside collision would almost certainly be fatal. The lead and chase vehicles provide higher visibility for the diminutive racers on rural country roads. The pace is determined by the strategists in the support vehicles; the race car driver is to keep the car on the road, drive as smoothly as possible, and follow instructions fed by teammates via radio. Each team is accompanied by an "official observer," provided by the sponsors, who makes sure the team follows all applicable traffic laws. Infractions are met with penalties, representing time added to the actual drive time each day.

***Photo B.** Inside view of the operating position in the back seat. Note power monitor control panel at bottom, keyboard drawer for storage while in motion, and printer on top of rack.*

With limited energy, a fixed schedule, tremendous competition, and years of work riding on the performance of each team, no one takes the race casually. Some schools have teams approaching 100 people in all aspects of the project, and may spend hundreds of thousands of dollars in design, preparation, and execution of the race. With such great stakes, every advantage available is considered and used, if possible.

As the total power requirements for the race car must come from the sun, the weather plays a very important role in how strategy is applied and how the day's course is run. Today and tomorrow's weather will affect the collection capabilities of the array. The daily course, whether hilly, flat, gradual incline, or steep slope, will determine the energy consumption of the car. Small towns with intersections, traffic lights, and railroad crossings all eat into your available energy supply. If you decide to pass another car to advance your position, you must weigh the gains versus the loss in energy. You must know not only how much energy you have stored, but how much you are currently using, what you expect to gain at the end of day, charging time, and what your use and charge rates will be tomorrow.

Weather Reconnaissance and Strategy

My participation was to provide onsite, real-time weather information and imagery. Although as a support vehicle I was required to drive an alternate route, radio contact and midday rendezvous enabled us to exchange the required information.

My Mitsubishi Montero, named "Mondo," was equipped to gather as much information as practical, although I have been told I was far beyond practical. The polar orbital U.S. NOAA and Russian MET series satellites operating on 137 MHz offer very detailed information on a fairly steady basis. With four American and two Russian satellites providing images, the selection would be great. I would also use terrestrial-based charts, graphs, and rebroadcast images from the GOES satellites.

For Sunrayce '93, the equipment rack in the back seat of Mondo held an HF ham band transceiver, general coverage receiver, antenna tuner, FM fax demodulator, VHF satellite receiver, satellite demodulator, computer, RGB-to-NTSC video converter, video monitor, high resolution large format video printer, 8mm taperecorder, plain paper printer, GPS receiver, and work lights. The antenna complement was the external GPS antenna, 144/440/900 amateur band/cellular antenna, 160–10 meter amateur band antenna, 150 MHz business band vertical, and a collapsible turnstile antenna for the APT satellites, similar to the "Zapper" as described in Ralph Taggart's *Weather Satellite Handbook.* This antenna was built on the principle of a blind person's cane, held together internally with elastic straps. The antenna would collapse to about 4" in diameter and 3' in length. A good "shake" and the antenna would snap into position. I would then place it in a boot atop the car and catch the satellite passes. This allowed me to run up and down the road without a satellite antenna on the car. It kept the competition guessing about what I was doing, as there were no telltale signs. Although the Zapper worked, it was less than impressive, at least by my standards. The team was happy, we had usable images, excellent weather prediction information, and that was that!

Mobile Imagery

As the months after Sunrayce '93 wore on, I became more interested in the possibilities of mobile imagery. I already knew I was going on Sunrayce '95, I just didn't know with whom, yet. I started to investigate the possibilities, while making preparations for Polarquest-'94 (don't ask and I won't have to tell you, but suffice it to say it had to do with the North Pole).

For serious APT images, especially the lower-angle passes which provide more east/west information, I needed more of an antenna. I also needed to get rid of more noise generated from equipment within Mondo.

Woodhouse Communication provided me with the answer, a circularly polarized yagi made especially for the 137 MHz band. Available in a rear-mount configuration, it was ideal for mobile installation as it eliminates the large vertical turning radius needed for "over-the-top" passes. The idea of a yagi mounted on a vehicle may seem a bit like overkill, but let me share with you

the essence of what I have learned over the past three years of mobile and fixed location imagery.

Nobody Knows the Noise I've Seen

There is nothing that can kill the quality of an image like noise! As if some deity out there just doesn't want us to mess around with APT satellites, every conceivable obstacle has been built into the system. Just look at the receiver bandwidth required for APT images. Forty kilohertz lets in a lot of noise. Sure, you can easily copy a signal of 1/2 microvolt on your 2 meter handheld, but you only have a 5 kHz bandwidth. The wide bandwidth, and the fact that 1/2 microvolt is more signal than frequently available for your satellite receiver, presents a challenge. Throw in the numerous high power front-end overload sources near the frequencies, and you need all of the help you can get. No, this is not rocket science, but LEO satellite reception at home is an entirely different world than from your car or van. Noise comes from all sorts of sources. I don't know what the criteria for meeting FCC Part B radiation is, but evidently it is just short of nuclear impulse.

The computer used to display the image, or to control the tracking system is the largest source of noise, yes, even up to 137 MHz! I have spent hours hand-selecting individual boards for use within the computer, substituting different brands of the same type of board, searching for the quietest one. There are significant differences. All input/output lines are decoupled with ferrite beads. The video monitor is another great source of noise. The more sophisticated the display, the greater the noise. This year I needed ESVGA to provide 1024 X 756 X 256 resolution. Big-time display, big-time noise! My demodulator has

Photo C. D-Day -2, final preparations done, ready to hit the road.

been tweaked like an Indy race engine, and additional decoupling and shielding has been added to the point where the manufacturer's original cabinet is only an outer shell, covering the added interior shielding. All power supply lines are shielded and decoupled. If you are afraid of diving into your expensive commercial equipment for which you don't have a schematic, this may not be the "motor sport" for you. Many pieces of equipment have feedthrough networks added to their power lines. All cables are insulated to prevent ground loops. Cables within the rack are separated by function to provide additional isolation, and some cables are actually laced into the position which radiates the lowest amount of noise. Power distribution using shielded wire is routed via separate circuits with individual circuit breakers for different functions. Each piece of equipment is bonded via an individual ground wire to the common rack/chassis ground. Remember, a good DC ground probably isn't very good at 137 MHz.

If you use a desktop computer, you need 110 VAC for power. Power inverters are a whole new breed of noise generators. I have found the new high-tech class D switching supplies will generate noise from 60 Hz to over 400 MHz. Even the HF ham bands become worthless with the buzzing drone of this type of inverter. Maybe there is a quiet one out there; however, I have tried five different inverters, all with the same results. The inverter I use is an antique bi-stable multivibrator type with a real E-I core transformer which goes a long way to limit its spread-spectrum capabilities. I never was successful in eliminating the rampant microprocessor noise in my new all-band all-mode HF transceiver; I just turned it off while catching passes. The only pieces of equipment which have not caused external noise radiation are the Vanguard WEPIX 2000B receivers, the AEA FAX, the KAM TNC and the previously used TS-820 and FRG-8800. With three major outings over the past three years, I have spent hundreds of hours determining noise sources, and eliminating them. If I can be of any assistance to you in similar endeavors, I hope it will be in preparing you for the challenge at hand, giving you some clues as to where to look for noise, and what may need to be done.

The problem is always the proximity of the noise source to the antenna. I have measured noise reduction of 40 dB, enough to eliminate the problem, just by moving the antennas 20' away from the car. Unfortunately, that is not a practical solution for these events. Your antenna will be within a few feet of the noise sources, so you must keep your nose to the grindstone.

Practice Makes Perfect

My planning for Sunrayce '95 started in April 1994, after making a commitment to Queen's University of Kingston, Ontario, Canada. There were a few "givens" to be reckoned with. The sunspot cycle would be at the bottom of the curve in June 1995. This means HF communication would be the worst it could be. As HF signals from numerous sources are absolute essentials, the HF equipment and antenna would have to be upgraded, and offer the highest performance available. I purchased a new FT-900 HF transceiver to replace both the old transceiver and the general coverage receiver. This saved a lot of space, reduced power consumption, and offered tremendous flexibility. The SGC-QMS antenna was selected as the HF antenna of choice. This superperformer provides complete coverage from 1.8 to 30 MHz. This would allow peak performance on the ham bands, as well as general coverage receiving. Always preparing for the worst, I packed a wind-up longwire. The "SMART-TUNER" in the QMS can tune

Photo D. Almost 4,000 later, on the triumphant return through the Badlands.

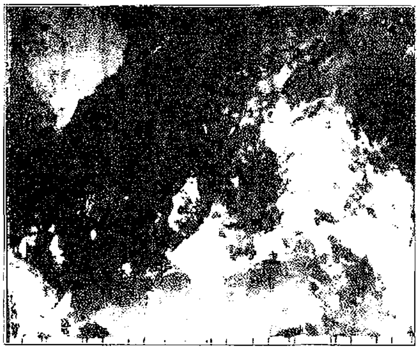


Photo E. NOAA satellite image showing the well-defined "V" cloud formation of a severe thunderstorm, just ahead on the race course.

an end-fed wire if more antenna is needed due to poor conditions. The VHF antennas would also need to be improved. Although I did my best to keep my activities quiet during Sunrayce '93, people figured out what I was doing, and I knew the competition would be inspired from Mondo '93. I would have to assume teams would try to emulate my efforts; I had to be at least a generation ahead of them. The APT-4X4RM I used on Polarquest was remarkable. At that time, I manually tracked the satellites. This year, I would use the computer for auto-tracking. I did not hesitate to install the APT-4X4RMX yagi and the APT2CP turnstile from Woodhouse. Keep in mind, putting full-sized VHF antennas on a car and running them down the road up to 10 hours a day, even in the rain and hail, requires extremely tough antennas. Weatherproofing is also important. A gentle shower on your roof becomes a gale force storm at 65 MPH! The possibility of full days of rain must be considered a reality. The antennas must perform, regardless!

The new equipment rack layout was started in December, with preliminary tests made as soon as the weather was decent. Being one of those Midwestern conservatives, I don't trust to luck, I trust to knowledge. The equipment rack and antennas were permanently installed on Mondo in April, which allowed two full months of fine-tuning, practicing, and preparing for any scenario.

On the Road

My team advised me about a month before the race that they had made arrangements for a professional meteorologist to accompany me. He would be bringing a small dish for data acquisition. *Wow!* Now this was really getting interesting.

Pam (my wife) and I arrived in Indianapolis on Saturday afternoon; the race started Tuesday. On the way to Indy, we continued "practicing" by capturing near overhead passes (###25) while on the move. After a casual look around at the solar cars, and a brief meeting with our team captain, we were introduced to Etienne Gregoire, the meteorologist supplied to the team by Environment Canada. ET, as he is called, is one of those people you like right off the bat. A mild manner, a good sense of humor, and an inquisitive mind made this look like a good relationship. Considering the time we were to spend together over the next 1,100 miles, and the work schedule that would develop, I was very pleased we drew ET from the pile.

"Applying our APT-gained information to the computer modeling gave us the truth."

ET came equipped with a 1.7 meter dish, a receiver, a computer, and 15 years' experience as a professional meteorologist. ET and I shared information on what was available from each other's services. From the ANIK E satellite, ET was able to pull all weather maps available from Environment Canada. We had regional radar summaries, computer models, cloud cover statistics, weather forecasts, observations from both private and public agencies, and custom-plotted solar insulation factors for the race route. I had all products from NAM/NMC, plus the polar orbitals. Just prior to the race, NOAA 9 was turned off for reasons unknown. NOAA 10 had been off a few months, due to course collision with NOAA 12. Of course, the Russians turned off MET 3-4, so we were left with three satellites for the duration. Marginal, but we could make it!

We compared time schedules for weather products, reviewed the daily schedule for the race and estimated our future locations for collection of products. We put together a plan for the next nine days and hoped for the best. I made a preliminary list of every NOAA and MET orbit during the race. I used Auto Map to roughly determine the long./lat. coordinates of locations along the route, and assigned reasonable time frames for our progress. This provided a list of possibilities, based on where we would be at any given time. The list was kept available for reference, but a second list was made of the required passes. This list was then integrated with my daily "activity schedule" and printed. The daily schedule was a list of activities I needed to perform, based on time and date. The day was spent checking off events as they occurred. Although near overhead orbital passes might be caught free-hand on the APT2CP, the longer passes which required tracking necessitated finding a suitable place to park Mondo, facing north, and determining our current position using GAPS. The exact coordinates were then entered into the tracking program.

The data ET was receiving would be used in conjunction with the images from the orbitals and additional charts from NAM/NMC. I was very pleased to hear from ET that the quality of the images I was gathering on the road were better than those available back at the office. As ET said, we know a front is going to move, we just don't know when, or how fast. Computer modeling will move the front based on many factors, all conjecture. We were able to view the front three times a day, and therefore knew exactly how fast, and in which direction, it was moving. Applying our APT-gained information to the computer modeling gave us the truth. We relied heavily on 72-hour predictions from HF sources, and reviewed the GOES images twice daily.

Any Good Boy Scout Is Well Prepared

I used the MultiFax demodulator and software for day-to-day use. As expected, the grid/mapping capabilities would come in handy. Reviewing the race course before leaving Kalamazoo, it became painfully obvious we could have some real "Where are we?" problems. The lack of geographic landmarks through the plains states coupled with the likelihood of fairly dense cloud cover would severely hinder our efforts. I took an hour or so and put together a "grid-map locator" database using every conceivable landmark that could be seen and identified from space.

Only two days into the race, we were cloud-covered! The team wanted to know "What's out there?" Reviewing a morning NOAA pass, I found two

landmarks for the map overlay. Would you believe the only landmarks I could find were the Great Salt Lake and the Door Peninsula of Wisconsin? Well, it worked! The map overlay allowed us to determine where in the clouds we were, and therefore to determine where and when our solar car could expect to find sunshine. This feature was used three times during the race, and was crucial to our success.

Another advantage we had was the extremely high quality images. We could capture the near overhead passes with the APT2CP, which is a story in itself. Briefly, I couldn't provide the clearance necessary for a complete antenna, so I used the roof of the car as a non-resonant reflector. The performance of the antenna was noticeably reduced, but I had been practicing and fine-tuning the entire system for the previous two months and knew the limitations. The APT-4X4RMX yagi coupled with the Yaesu AZ/EL rotor would allow us to reach out for the long passes. The 4X4 antenna provided incredible images, on passes as low as 9 maximum elevation; not bad for mobile! That meant we could get distant early morning passes to get an early look at the day, and look ahead to the west a long way on later passes. We could use passes not available to an omnidirectional antenna. This literally doubled the number of usable passes available to us. The directionality of the yagi was also a significant contributor to reduction of noise pickup from devices within Mondo.

Although I assume no credit for weather forecasting, we had all of the information needed, and ET was very skilled. We had no surprises; the weather happened just as predicted, when predicted. Over 4,500 miles were logged for Sunrayce '95, and another 1,500 miles were put on the equipment during preparation testing before the race. Everything worked well, with no problems.

Other Satellite Applications

I wasn't the only one using GPS on Sunrayce. Hughes was one of the major contributors for the event, and provided an interesting application of the telpath navigation system. The telpath system was developed for in-car use. A GPS receiver and a computerized map database and display will allow a driver to see where he is within a city. This can help guide the driver to the desired destination.

For Sunrayce, the application was to provide a GPS receiver for each vehicle team, connected to their cellular phone. The map display was the day's route, and the display(s) was (were) at the start/end of day and at the midday stop. You could approach a monitor and see the location of each car on the race course. This was a novel approach to provide the hordes of visitors a clue as to where their favorite car was.

Driving by the S-Meter

The first day was a short course, from Indianapolis to Terre Haute. After a glorious start at the War Memorial and Capitol building, with a rousing series of speeches and well-wishes from the Mayor and the Secretary of Transportation, the cars were off. We headed out of town toward Terre Haute. ET requested a chart from NAM in Norfolk.

Well, as expected, propagation was terrible, and by then it was about 1500 UTC. The morning propagation from NAM had shifted; we were somewhere between the short and long hops, if there were actually any hops at all. We were cruising down the highway, desperately seeking NAM on all frequencies programmed into memories on the HF rig. We didn't have time to stop; we had to get this one on the fly. I lit a cigar in frustration, while keeping my ear to the radio and one finger depressing the scan switch on the microphone. I noticed an 18-wheeler approaching in my side mirror. "Oh great!" I exclaimed. "Just what I need, the biggest shadow on the road and I have less than S-1 signal to begin with."

The rig slipped past me and as he started to pull back into the driving lane, the S-meter jumped. "Yes!" The perfect reflector for my antenna was now directly in front of me, and we were driving exactly opposite Norfolk. I asked Pam to check the map and see if this road would be straight for the next 25 miles. Upon confirmation that the road should be good, I began closing the distance between us and the large rear end of the trailer. I kept an eye on the S-meter, and sure enough, when we were about two wavelengths behind the rig, the S-meter jumped to about S-4. Good enough! I kept one eye on the S-meter, and one eye on the semi in front. I wanted to keep the signal as strong as possible, but even at 3 MHz, we were very close to a very large bumper! I believe Pam rested her eyes for the next half hour, and when I slowed down to back off from the trailer, she squinted into the back seat to view the monitor. "Well, you got it; I hope you're happy."

Amateur Spotters along the Way

From Indianapolis to Aurora, Colorado, teams of amateur radio operators provided spotting for the officials. Check points were set up along the route, and as each car passed, the time and car number were noted and passed

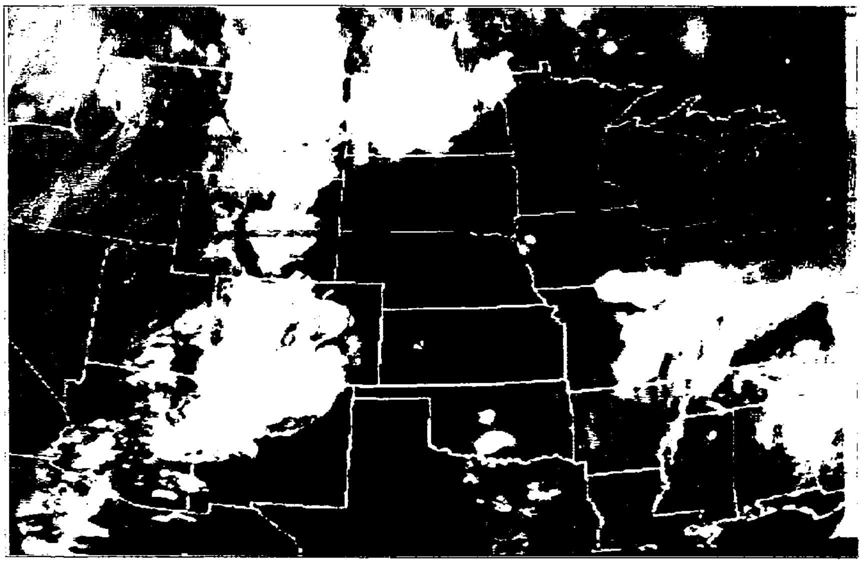


Photo F. Map overlay on NOAA image taken at Alton, IL. The overlay enabled us to determine the edge of the storm and hope for the rest of the day. The large front over the Rockies is beginning to move.

on. This was very beneficial in locating cars which might be suffering mechanical problems, and in keeping an overall eye on the progress.

Bennett Basore W5ZTN spearheaded this effort, as he did in '93. Bennett deserves some kind of sainthood award for his efforts and patience. Along the road we encountered every level of amateur, communication ability, and obstacle. Even though we frequently stretched the capabilities of local systems, and there seemed to be some deficiencies in preparation, every individual, club, and organization must be commended for their efforts. To achieve cross-country coverage during the week, many people took time off from work to be able to man the radios. I know there were many inconveniences faced by all involved, and the spotting locations were always less than where you would like to spend four or five hours!

Although Denver was not able to provide radio communication the last day of the race, the Denver area ATV group went all out and provided images from two camera locations to the end-of-race finish line. It was raining all day, and it was cold! Not only a miserable end for a solar event, but nothing short of hazard duty for the camera operators who stood by their cameras, providing continuously framed and focused images as cars approached the finish line.

QRX While I Reload

What's next? Hopefully by the time you read this, I'll be preparing to cruise across the Outback of Australia with the World Solar Challenge. The WSC is the other big event in solar-powered vehicles. This event is more demanding than Sunrayce, as the course is much longer and almost no one feels as if they are "at home." At the time of writing this article, I have a tentative invitation. For now, I am preparing, learning as much about the land down under as I can, and dreaming of tracking satellites upside down.

For more information; contact the author or review the following references on related subjects.

Useful Books

Weather Satellite Handbook; Ralph Taggart. ARRL.

The Weather Satellite Experimenter's Handbook; Martin Davidoff. ARRL.

Weather Radio. Anthony Curtis. Tiare Publications.

Space Satellite Handbook; Anthony Curtis. Gulf Publishing.

Exploring the Environment Through Satellite Imagery; Dr. Ann Berman. Tri-Space.

Guide to Utility Stations; Klingenfuss. Klingenfuss Publications.

Guide To Facsimile Stations; Klingenfuss. Klingenfuss Publications. 73

Souping Up a Surplus Field Strength Meter

Increase the sensitivity of your ME-61/GRC field strength meter.

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

An interesting piece of surplus test equipment that has been showing up lately is the ME-61/GRC field strength meter. I've seen them at both Dayton and the Dallas HAMCOM. These ME-61/GRC field strength meters have all been in sealed cardboard cartons (i.e. they are all unused). Prices seem to range from $15 to $25.

What is the ME-61/GRC? It is a tunable field strength meter "for use with such tactical radio systems as Radio Sets AN/GRC-9, AN/GRC-87, and AN/VRC-34," whatever those are. The instruction manual that came with my unit was dated 1966, so these are probably Vietnam War era products. It is interesting to read the instruction book section titled "Demolition to prevent enemy use" which, incidentally, comes right after the alignment and troubleshooting section.

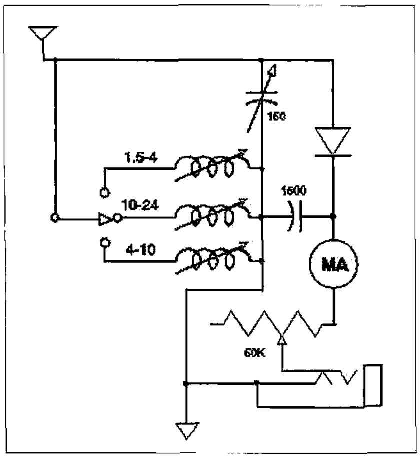


Fig. 1. Original circuit.

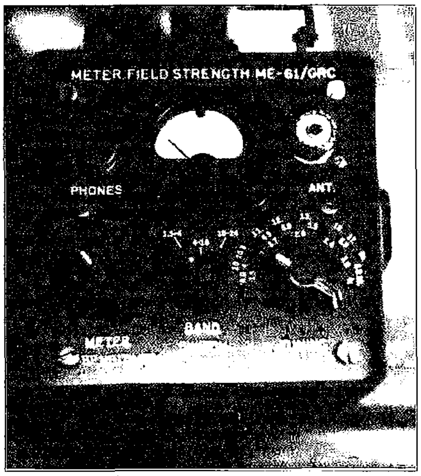


Photo A. *The ME-61/GRC field strength meter with the SO-239 connector.*

ME-61 FSM Description

The ME-61 FSM comes in a very nice military green watertight enclosure which includes a telescoping whip antenna and covers 1.5 to 24 MHz in three calibrated ranges: 1.5–4 MHz, 4–10 MHz, and 10–24 MHz (160 through 15 meters). As shown in Figure 1, the schematic, the ME-61 FSM covers these three ranges by switching in different inductors. The variable capacitor is common to all three ranges. A second bandswitch position (not shown on the schematic) also shorts out the unused inductors so that there is no mutual coupling between the used and unused inductors. The resulting parallel-tuned circuit feeds a simple diode detector and then a 1 milliamp meter through a 50k ohm variable pot. Headphones can be plugged into the phone jack for detecting AM signals. The ME-61 FSM works well; however, it is not that sensitive—due primarily to the 1 milliamp meter that the detector circuitry has to drive.

Modifications

There are typically two problems with the ME-61 FSM: The internal pull-up telescoping antenna corrodes easily, and the lack of sensitivity, as mentioned earlier.

My ME-61 FSM was similar to others that I had seen in that its antenna was corroded. I addressed this problem by completely removing the antenna and mount from the front panel. The hole that remains is just slightly larger than that required by an SO-239 UHF connector. Therefore, I centered an SO-239 on the hole and carefully marked locations for two mounting screws. After drilling #4 holes in the front panel, I mounted the SO-239 from the inside of the front panel. This looks good (see Photo A). For the antenna, I used a Radio

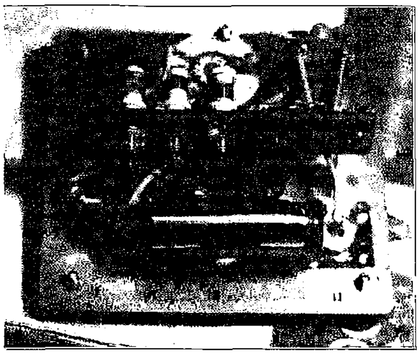


Photo B. *The inside of the ME-61, showing the battery hot-glued to the meter.*

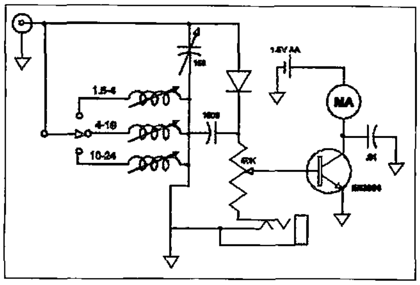


Fig. 2. New circuit.

Shack 270-1409 six-section cordless phone replacement antenna ($3.49) soldered to a banana plug (RS 274-721). The banana plug plugs into the center hole of the SO-239, and the collapsed antenna easily fits inside the cover of the box.

Now for the sensitivity improvement. As you can see from Figure 2, I simply rewired the metering circuitry and added a 2N3904 NPN transistor as a current amplifier (almost any NPN transistor can be used). I also changed the detector diode to a 1N34 germanium diode (RS 276-1123). The 1.5V AA battery is mounted in a plastic battery holder (RS 270-401) which has been hot-glued to the meter (see Photo B). You'll note that there is no on/off switch. With no signal input, the transistor can't turn on and therefore no current is drawn from the battery.

Results

The sensitivity improvement is significant. Before the modification, I could get no more than a half-scale reading at maximum sensitivity when I was located approximately 100 feet from my mobile antenna, running 100 watts output power. After the modification, I can get a full-scale meter reading at 100 feet with only 10 watts of output power, with less than full sensitivity!

Conclusion

If you would like a frequency-selective field strength meter, keep your eye out for the ME-61. The simple modifications described here can really turn the ME-61 into a valuable piece of test equipment. Other modifications can enhance the ME-61 even further. As an example, you might want to turn the 1.5–4 MHz range into a 15-40 MHz range if the higher frequencies are more interesting to you. Also, it is better to have an RF preamp ahead of the detector than a DC amplifier after it. You could replace the 50k pot with a combination 50k pot and switch for powering the RF preamp. Or maybe you could use the phone jack hole for something since most folks don't use AM detectors anymore. Experiment and have fun!

Microwaving on Monument Peak

The story behind our cover photo.

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San Diego CA 92119

I took the cover photo on top of Monument Peak (DM12SV) in the Laguna Mountain area of Southern California. This location is about 50 miles east of San Diego at an elevation of 6,300 feet. This operation was part of the ARRL 10 GHz contest in September 1991. 10 GHz contacts were to be attempted between the San Diego Microwave Group and a group of amateurs operating from Mount Union (DM34TK) at a 7,700-foot location near Montezuma Castle National Monument in central Arizona.

The photograph shows a portion of Monument Peak—real billy-goat territory—and our stations on top of a small pile of rocks, to which the two stations were anchored. Several bungie cords and cables were used to tie the equipment firmly to the rocks to keep them upright in the heavy winds. Kerry N6IZW is pictured on part of the rocks (our chair) just below his dish antenna and 10 GHz equipment during this memorable contact. The tower to the right is part of several commercial installations sharing this mountaintop location.

Our microwave shot is not a record distance, but consider that this path was obscured by several other mountains, making this attempt a tough challenge. The plan agreed upon was for the Arizona station to transmit during every even 10-minute period, and our station to transmit on odd 10-minute segments in case the lower frequency liaison could not be established. Ultimately, 2 meter SSB contacts were made. After some 30 minutes of antenna orientation and frequency scanning, both Kerry N6IZW and Chuck WB6IGP made contact with Dave KY7B within a minute of each other.

Signals were not strong initially but did increase to allow operation from all of our group members that day. Part of the reason that Kerry and I made contact first was that we both use similar equipment and 10 watts of power feeding a 30-inch dish antenna. Consider that our 10 watts of power and KY7B's 28 watts both feed high gain microwave dish antennas (34 dB gain), the product of which produces quite a high ERP power level. This gave us quite an edge when signals were marginal. As time elapsed, signals increased to S-2 for short periods of time.

Ed W6OYJ, John WB6BKR, and Jerry WA6VLF made contacts with two of the stations, operating with only 100 milliwatts. Signal conditions fluctuated, rapidly producing severe Doppler frequency shifts on SSB voice. Voice could be best described as a good Halloween ghost voice imitation due to multiple reflections and cloud scatter. We speculate this was partly due to reported heavy rain near our midpath calculations. Signals peaked quite high for a few moments and we suspect we were reflecting off aircraft flying through the same area. The biggest regret of this whole contact was that we had all forgotten our tape recorders for capturing the cloud scatter audio contact, useful for future brag sessions. 73

***Photo A.** Microwave operation in the San Diego mountains at an elevation of 6,000 feet above sea level. Making contact over the distant mountains required antenna alignment to be accurate within 1 or 2 degrees on the compass. Just beyond this vantage point, the mountain drops off 5,000 feet to the desert floor.*

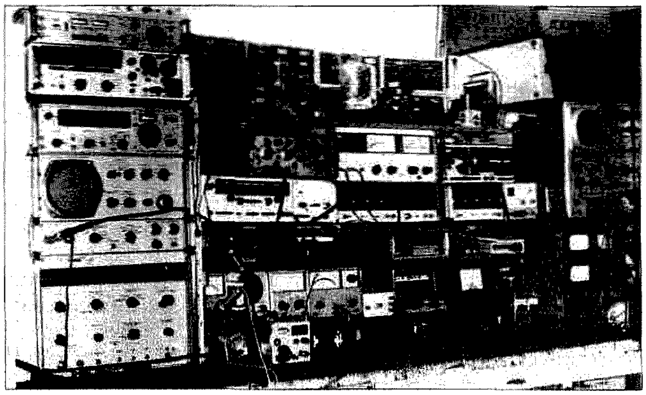

***Photo B.** The test workbench at WB6IGP. It's equipped with spectrum analyzers, sweepers, signal generators, vector voltmeters, scope and plain old VOM and solderings— a lot of junk that the power company would be proud of if I turned it all on at one time! This is where most projects get the final test.*

A Mobile Power Panel

Protect your vehicle and your rig.

Tony Marchese, N2YMW
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I recently obtained a 2 meter radio for my car. After consulting several sources, I was convinced that a direct connection to the battery was the best method to obtain power for the radio. This, however, presented me with an interesting dilemma. I was thrilled to have the radio but hesitant to connect equipment directly to the battery for fear of causing costly damage to the vehicle's electrical system. What I needed was a method to protect both the vehicle's electrical system and the radio equipment from subsequent power problems.

The power panel described in this article was designed to protect the vehicle and radio equipment. I have also used this opportunity to standardize the connectors on my own equipment, including the power panel and a 13.5 VDC supply. This simplifies movement of my equipment between various vehicles and my home QTH.

The power panel incorporates two levels of overload protection. The primary source of protection is provided by a set of inline, 15 amp, fast-acting fuses that are located close to the positive and negative battery terminals. These primary fuses guard against potential shorts from cable chafing and abrasions inside the engine compartment. A secondary level of overload protection is provided by a set of 7 amp fast-acting fuses which protect against electrical overload from high power equipment and potential cabling problems within the vehicle's cab. The secondary fuses are physically located on the exterior of the main power panel to allow quick access and easy replacement.

The almost inevitable need for noise suppression was satisfied by incorporating a filter network into the unit, thereby avoiding the unsightly rat's nest of wires which is sure to result if independent components are installed later. The power panel also incorporates an analog meter to monitor the current passing through the output connector. The meter is not essential for the system's operation and may be omitted if desired. I have, however, found this option to be particularly useful for monitoring the nominal current drawn from the battery during various operating conditions.

The power panel schematic is shown in Fig. 1. The 30 µH filter choke was constructed by winding 12 turns of 16 AWG insulated wire onto a T-200-1 powdered iron core. The 50 µA, 2.56k ohm analog meter movement utilizes the filter choke's 0.012 ohm winding resistance as a current shunt. This increases the full scale meter reading to approximately 10 amperes. The meter face has been highlighted in red from the 7 ampere mark to allow quick identification of the secondary fuse meltdown point.

The power panel also includes a relay which disconnects power when the ignition is off. The relay is activated by a separate power connection to an "Accessory" slot on the vehicle's fuse block. This prevents the radio from draining the battery if the unit is accidentally left on.

Construction of the power panel is fairly easy as no circuit board or special wiring techniques are required. All connections were made on a single barrier strip mounted inside the metal cabinet. I did, however, solder a 20 AWG wire directly to each end of the choke to prevent inadvertent disconnection as removal of the shunt resistance would allow the supply current to pass through and destroy the panel meter. Connect the opposite end of each of the smaller wires to the meter movement.

I produced the current version of the power panel in less than two hours. An additional hour was required to install the unit in my car. The time invested was well worth the effort as I can swap radios in under five minutes and not compromise my vehicle's electrical system.

Parts List

- 50 µA, 2,560 ohm analog meter movement (Mouser #564-72T-1050 or equivalent)
- T-200-1 powdered iron core (Amidon Part #T-200-1)
- 2200 µF, 25V electrolytic capacitor
- (2) 7 ampere, fast-acting fuses with panel mount holders
- (2) 15 ampere, fast-acting fuses with inline holders
- 36" section of 16 AWG insulated wire
- 12 AWG THHN or equivalent wire (enough to reach from battery to power panel)
- DPDT switch with contacts rated 10 amps (minimum)
- 12V lamp with holder
- Panel-mount, female connector, 10 amp contact rating (minimum) and mating male plug
- 6-position or larger barrier strip
- 6-10" of small gauge wire
- Metal cabinet
- Misc. hardware
- 12V SPST relay with N.O. contact (Mouser #526-R22-1D16-12 or equivalent)

Mouser Electronics: (800) 346-6873.
Amidon Associates: 12033 Otsego Street, North Hollywood, CA 91607.

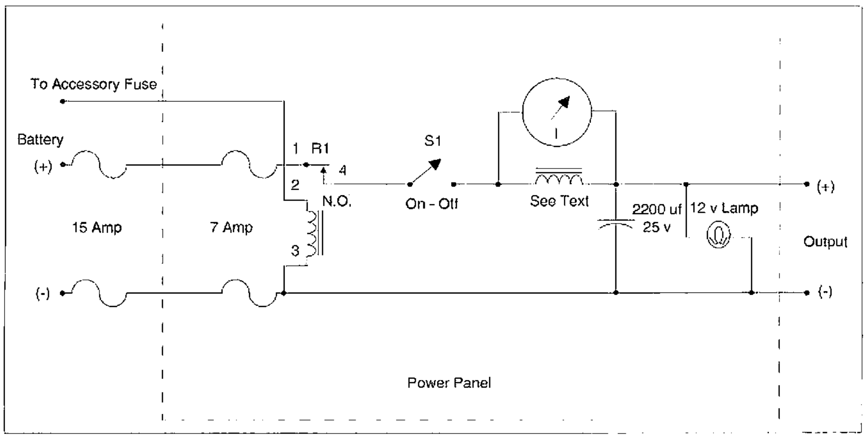

Fig. 1. Schematic for the power panel.

Do You Remember?

Glen E. Zook W5UOJ
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Richardson TX 75080

Every once-in-a while, many amateurs like to take time to reflect, time to remember. About 20 years ago I wrote a similar article which Wayne published in *73* which met with a favorable response from the readers. This one has been updated somewhat, but is still aimed at the over-25 crowd. Over 25 years as an amateur, that is, the QCWA crowd. However, newer amateurs might just get a kick out of trying to make sense of the following list. But, if you have to ask any questions, then you really don't remember.

So, without further ado:

Do You Remember?

The "Sixer," "Twoer," and "Tener"?

ARC5s?

The "Dream Receiver" (the one I owned was more like a "nightmare"!)?

The BC779?

The "My QTH" QSL cards?

When VO was a separate country from VE?

When the "ideal" Novice rig was a DX40 and an SX99?

Controlled carrier modulation?

DSB?

The SX101A?

The VF-1 VFO?

The DX20, DX35, and DX60?

The 30L1 transmitter (not the 30L1 linear!) by Collins?

The KWM1?

The original "Bandit"?

The TBS50D (160 through 2!)?

The HRO series?

When an 807 was a tube, not a drink?

The 814?

The G66 and G77?

The one-eyed "Gooney Bird"?

The second generation "Gooney Bird"?

When Novices could operate 2 meter phone, but Technicians couldn't?

Crystal control and 75 watts?

When the "Adventurer" and "Challenger" were not space vehicles?

The Drake TV300HP?

Using a BC459 or BC457 as a VFO?

"Rice boxes" and "Japtracs"?

The 16V and 30D?

8th MOs (and even earlier!)?

The 41V and 80D?

The 75A1?

The AF67 (or even earlier, the A54H)?

When a "tribander" was a converter, not an antenna?

The NC240D?

The NC183D (or even earlier, the NC173)?

The "Sky Buddy"?

The S40B?

The S77?

Globe Chiefs and Globe Scouts?

The Apache, Mohawk, and Seneca?

The Mohican?

The KWS1?

Leo?

When Leo had hair?

The orange QSL cards from Walter Ashe?

The logbook QSLs from GE?

HI HI HI HI from space on CW?

The Invader and Invader 2000?

Pedestals?

The quad at HCJB?

The Central Electronics 10B and 20A?

The CE 100V?

Modifying a BC458 to use with a CE 10B or 20A?

The Techcraft coverters?

International Crystal 6 meter rigs?

The Lincoln?

Knight Kits?

The R100A?

The Swan 120 (or 175, or 140)?

The Swan 240?

Heath monobanders?

The HQ129X (or, even earlier, the HQ120X)?

The SP600?

Your first QSO?

"Bugs", not keyers?

The Vibroplex Champion and Standard?

Astatic?

When W9IOP (also W8IOP, W2IOP, etc.) won the Sweepstakes every year?

W9VW (hint: Look at W9IOP DX contest scores)?

The 75A4?

The S85?

The HQ105TR?

When Johnson built only ham gear?

The AT-1 and AR-1 (I owned an AR-3)?

6AG7-807 (or even 6V6-6L6)?

The 2E26 and 6146?

When the 829B was the "cat's meow" on 2 meters?

The SCR522?

ROWH (Royal Order of the Woulf Hong)?

ROHO (Royal Order of the Hoot Owls)?

"No lids, no kids, no space cadets..."?

W2OY (I got on his "reserved" frequency once!)?

W5IO ("I know this guy, he bought a donkey...")?

ZL2BE (and his 20 wavelengths on a side rhombics)?

The rhombic?

100 North Western in Chicago?

When Lafayette was across the street from Allied?

When Radio Shack bought Allied?

Olson?

"California Kilowatts"?

AGL Electronics?

6 Up Magazine?

Western Radio Amateur?

When W2NSD ran *CQ*, not *73?*

Cowan Publishing?

Zepp Antennas?

The T2FD?

"Radiates equally as poor in all directions"?

The DX100?

The SB-10?

The quad-versus-yagi debate?

AR22 rotors?

Prop pitch motors?

Selsyns?

The Communicator III?

WR calls?

When an "X" call meant experimental?

Continued on page 60

Basic Packet Modem

Greg Cerenzia N3PRT
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Lexington Park MD 20653

Want to get on packet for a minimum investment? Want to try packet without the cost of buying a TNC? Or would you like to operate portable packet without taking your TNC with you? Then this is for you! This project is an easy-to-build Bell 202 1200 baud packet modem that is powered from the computer's serial port and requires a minimum of parts. While it is not a TNC by itself, the modem and a software TNC program running on your computer can perform many of the same functions as a TNC and will get you up on packet for a minimal investment. (Note: This project is available in kit form from LDG Electronics. See the Parts List for ordering information.)

When I first decided to build my own packet modem I was surprised that not much information was available. After doing lots of research, reviewing technical notes from the modem chip manµFacturer, and experimenting, I found that the modem chip could work with only a few added components. I have used this design for over a year as of this writing and it works well. Members of our local club have also built this project and are happy with the results.

Uses

This modem is designed to work with the serial port of most IBM-compatible computers. A software TNC program is required for operation and most BBSs have shareware TNC programs available for downloading. Known compatible programs are Baycom and SofTNC from j•Com. (Although SofTNC works well when configured for com 1, I have not yet been able to get it to work on com 2.) I have seen numerous other software programs and drivers on the Internet for this type of modem that allow TCP/IP use, games, and Windows-compatible programs, etc. With the simplicity of this setup I am sure that others will continue to be developed.

Circuit Analysis and Operation

The software TNC program is the heart of this setup. Most of these programs have the same major features in common. They provide a memory-resident AX.25 packet protocol, a user terminal interface to send and receive from, and a means to access the computer's serial or parallel port. It should be noted that most software TNC programs do not use the standard RS-232 pins of the serial port. They use the DTR line for TXD, the CTS line for RXD and the RTS line for PTT. Therefore, these programs were written specifically for this type of modem.

Photo A. The author's Basic Packet Modem setup with radio, cables and laptop.

Refer to the schematic, Fig. 1. Power is supplied to the modem from the computer by the TXD, DTR and RTS lines of the serial port. Diodes D1, D2 and D3 allow the positive voltages to reach the voltage regulator VR1 to power the circuit, but do not allow these lines to interfere with one another. Most software TNC programs will raise the TXD line of the serial port high constantly while the program is running. They will also keep the DTR line high while receiving. When the RTS line goes high to key the radio, the DTR line will send data by toggling high and low. The high TXD, high RTS when keyed, and high pulses of the DTR line provide power to VR1, which supplies the circuit with the required 5 volts. Capacitors C1 and C2 provide filtering and stability of the regulator and the output voltage.

IC2 is a 74HC04 CMOS hex inverter. It draws less current than a standard 7404, which is why it was chosen for this circuit. It performs the dual functions of inverting the appropriate signals and serving as a pseudo RS-232 to TTL line converter.

To key the radio, the software raises the RTS line of the serial port high. Since almost all radios require their PTT line to be pulled low to key the radio, this high level must be converted to a low level or ground closure. The high RTS goes to pin 3 of the inverter and is converted to a low output on pin 4,

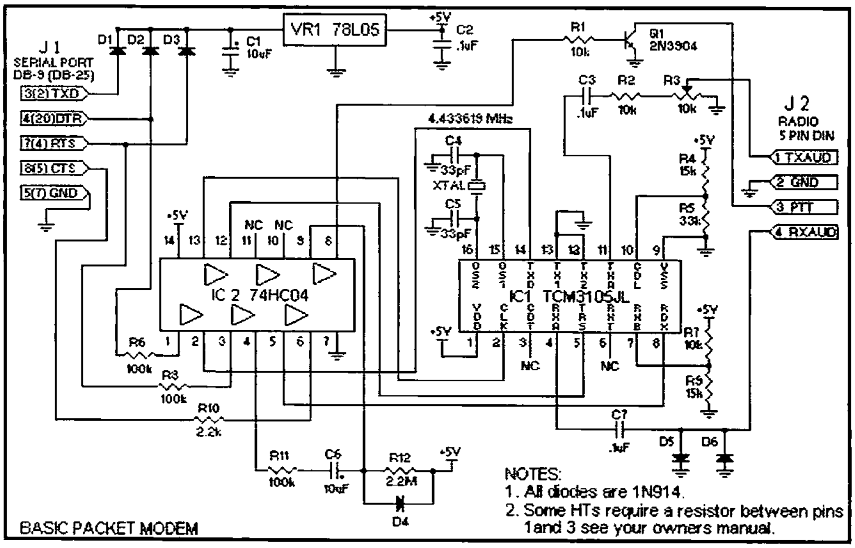


Fig. 1. Schematic for the modem.

where it is routed to a time-out circuit and to pin 9 of the inverter. The low on pin 9 is converted to a high on pin 8 that turns on Q1. When Q1 turns on, it provides the low or ground closure for the PTT of the radio.

The keying time-out circuit is provided in case the software hangs up or you run another program that raises the RTS line high. It prevents your radio from either causing interference on the channel or burning up! The circuit is comprised of capacitor C6, resistor R12, and diode D4. As soon as the software raises the RTS line high, pin 4 of the inverter goes low. This allows C6 to start charging through R12. After C6 charges to about one time constant (approximately 20 seconds), the voltage "seen" at pin 9 will be high enough to cause pin 8 to go low, thus unkeying the radio. C6 will continue to charge until it reaches a charge close to the supply voltage. D4 is provided to keep pin 9 from seeing the 5V supply to the timer circuit. When the RTS line goes low, C6 will discharge and the timing circuit will begin again on the next key.

IC1 the TCM3105JL chip is the main component of the circuit. It is a single chip asynchronous Frequency Shift Keying (FSK) voice band modem that can be jumper selected to the Bell 202 modem standards. A pin-by-pin description of the modem chip follows:

Pin 2 (CLK) is a clock output. It is sent to the hex inverter and then fed back to pin 5 (TRS) of the modem chip to provide an inverted clock signal for Bell 202 mode.

Pin 3 (CDT) provides a carrier detect output. It isn't used on most serial port software TNC programs, but can be hooked up for certain applications that may require it.

Pin 4 (RXA) is the receive audio input. C7 is an AC coupling capacitor and D5 and D6 form a clipper circuit to limit the audio input to the modem chip.

Pin 7 (RXB) is the receive bias. The bias voltage tells the modem's internal comparator at what level to slice the DC variations fed to it from the internal multivibrator demodulator.

Pin 8 (RXD) is the comparator's output. This is the receive data that is inverted and then fed to the computer's CTS port.

Pin 10 (CDL) has a level set by R4 and R5 for the pin 3 (CDT) output.

Pin 11 (TXA) output of the modem. It is AC coupled by C3 and its' level is set by R2 and R3.

Pins 12 (TX1) and 13 (TX2) are strapped together and tied low for the Bell 202 mode.

Pin 14 (TXD) transmit data from the computer's serial port is inverted and then sent to modem on this pin.

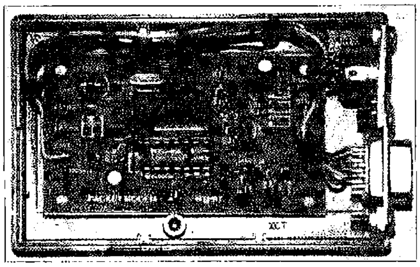


Photo B. The completed circuit board installed in case.

Pins 15 (OS1) and 16 (OS2) are the connections for the 4.433619 MHz crystal and C4 and C5 capacitors which set the frequency for the on-chip oscillator.

Construction

Construction is pretty straightforward. See the Parts List and refer to the schematic diagram (Fig. 1) for component interconnections. When installing the parts, observe proper orientation of the diodes and capacitors. Note that the miniature voltage regulator looks identical to the transistor, so check them before you install. To prevent damage to the ICs, use sockets and install them last. You can construct this circuit on perf board. I have built one this way, but it was pretty messy, so unless you are a skilled perf board builder the printed circuit board is recommended. See Fig. 6 for the circuit board layout.

Enclosure

The enclosure listed in the Parts List is small and has a removable battery cover to accesses the potentiometer R3 level adjustment. If you chose to use this enclosure you will have to remove the battery compartment divider by carefully cutting it out with a hobby knife or rotary cutter. Do not try to bend and break it out, because you will probably destroy the enclosure. Use the front panel and carefully drill and file to mount the 5-pin DIN chassis mount connector and the 9-pin D-SUB female with 4-40 screws and hex nuts. It may be necessary to file the corner off the 9-pin D-SUB connector for both of these to fit. Do not overtighten the screws or you will damage the front panel. A sturdier front panel can be made from aluminum cut to the same size as the plastic panel.

Use short runs of wire and connect the circuit board to the appropriate pins of the connectors on your enclosure. Refer to Fig. 1, 2, and 3.

CIRCUIT BOARD TO J1 SERIAL PORT CONNECTIONS

CIRCUIT BOARD	FUNCTION*	J1 CONNECTOR, DB-9	OR DB-25
TXD 3	POWER	3	2
DTR 4	TRANSMIT DIGITAL DATA/POWER	4	20
RTS 7	PUSH-TO-TALK/POWER	7	4
CTS 8	RECEIVE DIGITAL DATA	8	5
GND 5	GROUND	5	7

Note: The functions listed are referenced for this modem. They are not standard RS-232 functions.

Fig. 2. Pinouts from the circuit to the enclosure's J1 data connector.

CIRCUIT BOARD TO J2 RADIO CONNECTOR

CIRCUIT BOARD	FUNCTION	J2 5-PIN DIN
TXAUD 1	Transmit Audio	1
GND 2	Ground	2
PTT 3	Push-to-Taik	3
RXAUD 4	Receive Audio	4

Look at your 5-PIN DIN connector numbering carefully; it is not numbered in sequence. This view, looking at the solder side of the chassis connector, should help:

TXAUD-1 3-PTT
RXAUD-4 5-N/C
2-GND
Modem Chassis Connector Solder Side

Fig. 3. Pinouts from the circuit board to the enclosure's J2 radio connector.

COMPUTER FEMALE CONN.		FUNCTION*	MODEM MALE CONN.	
DB-9 OR DB-25			DB-9 OR DB-25	
3	2	POWER	3	2
4	20	TRANSMIT DIGITAL DATA/POWER	4	20
7	4	PUSH-TO-TALK/POWER	7	4
8	5	RECEIVE DIGITAL DATA	8	5
5	7	GROUND	5	7

Note: The functions listed are referenced for this modem. They are not standard RS-232 functions.

Fig. 4. Pinouts from the computer to the modem interface cable.

5-PIN DIN		FUNCTION	RADIO CONNECTOR
TXAUD	1	Transmit Audio	A/R *
GND	2	Ground	A/R
PTT	3	Push-to-Talk	A/R
RXAUD	4	Receive Audio	A/R

Look at your 5-PIN DIN connector numbering carefully; it is not numbered in sequence. This view, looking at the solder side of the plug connector, should help:

3-PTT 1-TXAUD
5-N/C 4-RXAUD
2-GND
Plug Connector Solder Solder Side

Note: Refer to you owners manual for the pin-out of your radio connector.

Fig. 5. Pinouts from the modem to the radio cable.

Computer Data Interface Cable

Some computer data cables are on the expensive side and since you have already built your own modem; why not build your own data cable? A standard data cable will work, but for this interface five lines are all that is required. Refer to Fig. 4 for the pinout. If you purchased the bulk data cable in the Parts List, the shield counts as the fifth conductor (GND). The shield should be twisted together and have heat shrink put over it to form a wire. You may also want to put some heat shrink over the data cable where it enters the backshell. This will provide firmer clamping once the backshell is assembled. Note that this cable is for this modem only. It won't work with a landline-type modem, because some of the other lines required are not used in this interface. You can build a cable to go from DB-9 to DB-9 or DB-25 if your computer has a DB-25 serial port.

Radio Interface Cables

The stereo cable for most audio systems and VCRs makes a great interface cable for handhelds. It gives you two separate cables for each of the radio connectors to attach, but is still joined together as one cable. Simply cut the phono plugs off and cut the cable to the desired length. You may want to put a small piece of heat shrink over the cable to keep it from "zipping" apart. Then attach the radio mini-plugs. Refer to your owner's manual for the proper pinout of the radio plugs and to see if a keying resistor is required for your handheld. Handhelds that have no separate push-to-talk line incorporate it into the transmit audio line of a remote microphone. This transmit audio line has a DC logic high that is usually "blocked" by a capacitor installed in the mike. In the modem circuit capacitor C3 performs this "blocking" function. An AC audio signal can coexist on this same line without the DC signal interfering. When the PTT line of the modem goes low the keying resistor causes a voltage drop from the DC high, thus making the radio key without shorting the audio signal to ground. If your radio needs this resistor it can be easily installed inside the backshell of the 5-pin DIN plug between the TXAUD line and the PTT line. Usually a 2.2k or 3.9k resistor is used, depending on the make of the radio, so check your owner's manual for details.

For mobile rigs, the same cable type that was used for the serial port interface cable can be used. You may want to add some heat shrink where the cable enters the backshell of the radio connector to provide better holding when the clamp is tightened down. Refer to your owner's manual for the proper pinout of the radio connector. Most mobile rigs can have the PTT line hooked up directly without a keying resistor. The pinout for the 5-pin DIN mating plug for the chassis mount plug is shown in Fig. 5.

Setup and Adjustments

If you are new to packet now is a good time to invite someone with packet experience to help you. They will be familiar with the various packet settings in the configuration file of your software, and may be able to help if you have any other problems. If no such person is available, I'll try to give you some brief pointers to get started. Read the documentation for your packet program thoroughly. Set up the configuration file for your callsign, COM port and any other custom information for your computer, etc. Turn off your computer (most computer manµFacturers recommend doing this before hooking up peripherals to ports). Hook up your radio and computer to the modem then turn on the computer and run the TNC program. Unsquelch your radio and adjust the volume just to the point where the RX indicator of your program comes on or flashes. It is not necessary to increase the volume beyond this point.

If you are on an active packet frequency you should now be able to monitor decoded packets on the screen. If not, check your software setup and manual. Read the instructions for your software on how to connect to another station. Hopefully everything is working fine. If not, here are some troubleshooting tips.

Troubleshooting

If your modem is not working properly, don't panic. It is usually something simple. Listed below are some of the common problems, solutions and troubleshooting tips. All of these tests require that your modem be connected to the computer, with the software TNC program running. If, after following these steps, you still have no luck, use a multimeter, the schematic shown in Fig. 1, and the theory of operation section to track down your problem.

Using a multimeter, check for continuity and shorts in the interface cables to

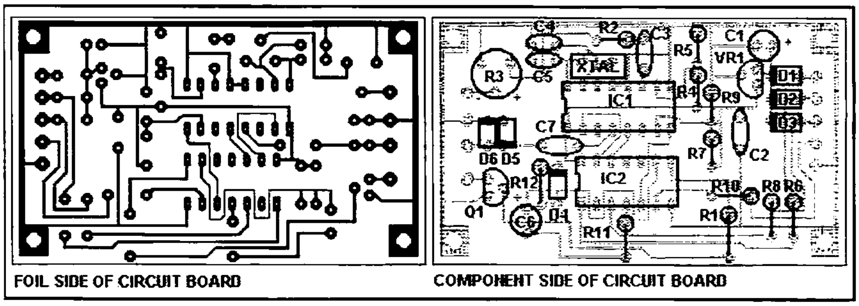


Fig. 6. Circuit board and component layout.

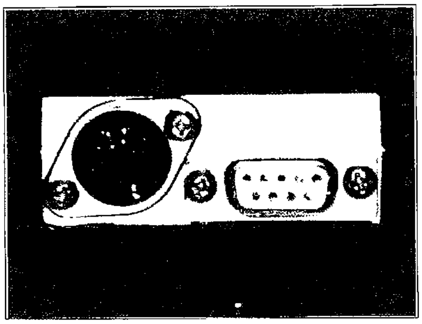


Photo C. The front panel showing the 5 Pin DIN radio connector and the DB-9 computer connector.

the radio and computer and wiring to the connectors and circuit board of the modem.

Make voltage readings on IC1 pins 1 and 9, IC2 pins 14 and 7. You should have a voltage very close to 5V. If not, check for a 5V output on VR1 at the point where it connects to C2.

If your radio keys up and you are using a handheld with a keying resistor, try reducing R3 until it unkeys. If you still cannot get the radio to unkey and are sure everything else is OK, R2 may have to be replaced with a lower value resistor.

If you are not receiving packets, first make sure that the software TNC program you are running will allow you to monitor what is happening on an active channel and that you are using the proper serial port. Then find the status indicator of your program. When your S-meter or busy indicator shows activity on your radio the RX or RECV indicator of your program should light. If not, try unsquelching your radio . White noise from the radio will cause the indicator to light if the volume level is high enough. It should not be necessary to turn the volume above halfway. If you see no receive indication, check for power to the modem.

If others are having trouble decoding your packets try the R3 adjustment that affects the audio output level. In testing, over-deviation was almost impossible with the radios tested. However, distortion was not. Too high a setting will cause the audio to be distorted and the receiving station may have some problems decoding your packets. If you see too many REJs (REJECT), try lowering the output slightly. Usually, about midway works fine. Also, try increasing your transmit delay time in your TNC software program.

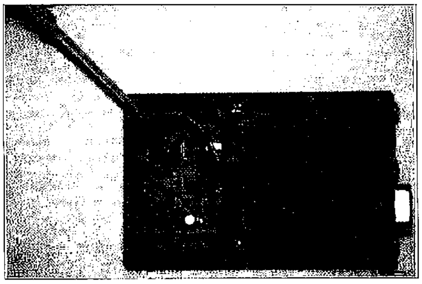


Photo D. The bottom cover of the case removed to get to the audio level adjustment.

If your radio is not keying and it is a handheld, refer to your owner's manual to see if it needs a keying resistor. Radios that use this resistor will not key properly without it. For radios using a separate PTT, disconnect the cable from the radio and connect an ohmmeter between the PTT line and GND. When the program transmits, you should see close to 0 ohms. Also, check to see that Q1's emitter is grounded to the radios' ground when the cable is hooked-up, and that the base of Q1 is going high when the program transmits. If not, check for power to IC2. If that is OK, see if pin 3 goes high when the program transmits. If not, either the program is set up for the wrong serial port or there is a problem with the serial port.

A quick check to see if your modem is active and transmitting packets can be done by unhooking the connector(s) from the radio and hooking headphones with some jumper clips to the TXAUD and GND lines on the radio connector(s). You should hear a low-level high-pitched continuous tone. When you send a transmission such as a connect request, a familiar packet burst sound should be heard momentarily, then the continuous tone will return. If you obtained these results, the modem is on and is transmitting data.

If your setup is working but acting erratically or the computer locks up, etc., RF is probably getting back into the computer or modem. The effect of RF appears as your computer monitor's picture jumping with each transmission relative to the power level you're operating at and the location of the antenna. The radio may also stay keyed after the first transmission or cycle back and forth. Usually it will help if you remote your antenna away from the packet setup or reduce power. For handhelds, use an antenna extension cable for mobile use with a rubber duck antenna or an outdoor antenna that can be located away from your station. Computers and monitors can generate a lot of noise. This may get into your receiver and be strong enough to keep your radio unsqelched. Again, moving

Photo E. The Basic Packet Modem is very portable and requires no external power.

your antenna or moving the location of the radio or cables should solve the problem. Some of the later versions of TNC software programs have a carrier command that can be set up for unsquelched operations. I have used this with much success.

Tips for 10 Meter Operation

Packet on 10 meters can be used between 28.0 and 28.3 MHz sideband. You can usually find packet stations on the lower sideband. Check your repeater directory for listings of 10 meter packet BBSs. Running sideband packet is a little different from 2 meter. Tuning is a little more critical, but once you get it dialed in you should have no problem. Also, if you are working DX packet stations, try increasing your retry count. It sometimes takes a little longer if the band is fading back and forth. It is possible to run unsqelched on sideband due to the lower receiver noise on sideband. First, set the volume so that the receive indicator of your software just comes on. Then back it off some just till the indicator goes out. When packets come in, the audio level is higher than the noise level of the receiver, and the software TNC program will go to receive mode and decode the packets. When the band is open strong, this works great. If the band is a little weak and fading in and out, you may have to "work" the volume control of the radio some. Using squelch on sideband will require the sending station to use a much longer transmit delay time. This longer delay time will send an audio preamble before any data is sent. Since audio is required for the squelch of a sideband radio to break, the audio preamble will first break your squelch. After the preset delay time, the data will be sent. If you are going to do lots of 10 meter packet, I highly recommend a software TNC program that has the carrier command for running open squelch.

Conclusion

I hope you have as much fun with this project as I did. I also hope that it has taken some of the mysteries out of packet and encouraged you to

experiment on your own. By putting the "brains" in the computer, programmers can come up with limitless options and upgrades that we can all afford. 73

(Photos by Jay McClain N3HUH.)

Parts List

All resistors are 1/4W, 5%-tolerance carbon-film unless otherwise specified.

C1, C6—10 µF, 50V, radial-lead electro lytic capacitors (Jameco 29891)
C2, C3, C7—.1 µF, 50V capacitors, ceramic (Jameco 15270)
C4, C5—33 pF, 1,000V capacitors, ceramic (Jameco 97244)
D1-6—1N914, diode (Jameco 36038)
Q1—2N3904, transistor (Jameco 38359)
R1, R2, R7—10k (Jameco 29911)
R3—10k PC-board horizontal-mount trimmer potentiometer (Radio Shack 271-282)
R4, R9—15k (Jameco 30146)
R5—33k (Jameco 30841)
R6, R8, R11—100k (Jameco 29997)
R10—2.2k (Jameco 30314)
R12—2.2M (Jameco 30365)
IC1—TCM3105JL Texas Instruments Bell-202 modem chip (Marshall Industries, 932 Telstar Ave, El Monte, CA 91731; tel: 1-800- 522-0084)
IC2—74HC04 hex Inverter (Jameco 45209)
VR1—78L05 miniature voltage regula tor (Jameco 51182)
XTAL—Crystal 4.433619 (Jameco 102630)
16-pin IC socket (Jameco 37372)
14-pin IC socket (Jameco 37161)
5-pin DIN chassis mount connector (RS 274-005)
5-pin DIN plug (RS 274-003)
9-pin D-subconnector, female (RS 276-1538)
Enclosure (RS 270-293)
Radio connector(s) as required for your radio

Jameco Electronic Components,
1355 Shoreway Rd.,
Belmont, CA 94002-4100
phone: 1-800-831-4242

A kit containing circuit board and components is available for $34.95 + $5.00 S&H from:
LDG Electronics,
1445 Parran Rd. St.
Leonard, MD 20685
Phone 1-410-586-2177.
Visa and MasterCard orders are accepted.

LETTERS
Continued from page 6

I was an avionics officer in a special operations unit. I am an Air Force Reserve colonel today, attached to one of the alphabet agencies. Along the way I earned a B.A., B.S.E.E., M.B.A., and finally a Juris Doctor degree. The law practice supports my Air Force Reserve activities and pays for the DC-to-light ham gear. Thanks for the inspiration along the way!

Now for the important part. I just completed teaching three classes of sixth-graders a little about ham radio, shortwave listening, and opportunities in electronics as a career. I also donated $200 in "Now You're Talking" books to the school library and arranged classes with the local club. I also have given two subscriptions to your magazine to kids. My son, Barry KE4PUD (Passed Up Dad), earned his Novice license at age 9 and upgraded to Tech Plus at age 10. He is now 11 and working on the General.

If possible, please publish this little story as an incentive for some other aging Baby Boomers to get off their rears and invest some time and money in the future. Get the kids interested in electronics and engineering. If we do not help to mold the next generation there will be no amateur radio and a lack of engineers and technicians in the future. Please continue publishing and leading.

Sorry about 6-Up, *but it was a 1965 victim of the state employment police who stopped me from using high school kids for 50¢ an hour after school to address and mail the little magazine unless I paid them at least the minimum wage. The kids were happy to make some money and learn about publishing, but the employment department wouldn't let them do it, so I had to give it up. Hey, keep up the work with the kids, that's fantastic... Wayne)*

Jeff Olstad, BC. In response to your "Whadaya Read?" in the September issue, I am a flat beginner. I don't have my first license yet. I bought this issue to try and learn more about ham radio in general and more specifically antennas. It is my second issue of the magazine. When I read my first copy I thought if this magazine's circulation is good they would not listen to any advice from me, but seeing as you asked, I thought I would try to explain what I think. It is pretty obvious to me why your circulation is suffering. You insult the people who should be the bulk of your readers in many articles: the licensed operators. For beginners like myself you use so many abbreviations and make so many references to things you don't explain. Without a comprehensive reference library it's unreadable. So who is left that has any use for *73?*

(Thanks Jeff, sort of. First, you should be collecting 73 *magazine issues so you'll have a valuable encyclopedia of ham information that you're going to need later on, after you've come up to speed. Get out to hamfests and collect as many back issues as you can find. They're solid gold when you want to get started with RTTY, packet, SSTV, and so on. Second, the magazine's circulation isn't suffering, it's doing fine. I just want it to do even better. Third, what's all this about insulting people? Anybody else have a problem with that? Sure, I'm on your case about losing weight, stopping smoking, and not wasting your time with baloney like ball games and sitcoms when you could be reading and educating yourself...there being a known correlation between education and success. Or getting more involved with hamming and having a ball while you are learning. But I wasn't aware I, or any of our columnists, have been insulting about it .. Wayne)*

Continued on page 35

UHF/VHF Home-Brew Measuring Gadgets

Accurate, easy, satisfying.

John C. Reed W6IOJ
770 La Buena Tierra
Santa Barbara CA 93111

Take UHF power measurements? No problem. I simply place a diode across the 50-ohm line and the power will be

$$\frac{E^2}{R}$$

—and don't forget that the diode is a peak-reading device. Then I multiply the peak by 0.707 to bring it down to the RMS value. This means I'm assuming a sine wave input. Do I really have a sine wave?

Another thing: Diodes have lead-length inductance and junction capacitance. I wonder what that's doing to my load line? And speaking of the diode, everyone knows a diode is linear except at the lower levels. I wonder at what level this nonlinearity starts, and what the characteristics are? Also, there must be a diode rolloff. Where does that start?

These are the kinds of questions that come up when you measure RF power using a diode detector. The following article describes simple methods that address such considerations, and the hardware you can build to make accurate measurements.

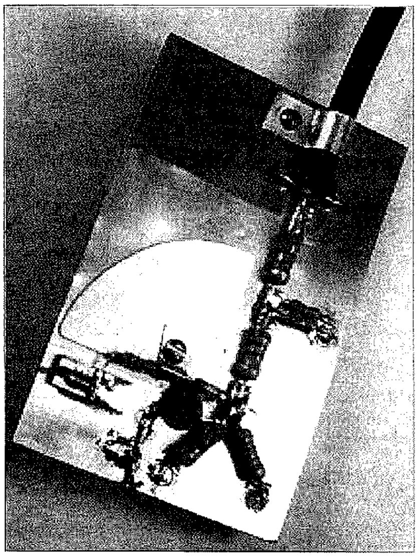


***Photo A.** The dummy-load/detector.*

This hardware includes a dummy-load/detector assembly (see Photo A) permitting 0.2 mW to 5 watts power measurements down to 70 cm, and a separate 10 dB attenuator (see Photo B) that increases this capability to 50 watts. Also included is a very simple thermal-type power measuring device for calibrating the peak reading diode assembly versus RMS input power. All parts for building these assemblies are available at Radio Shack®.

Dummy-Load/Detector

See Fig. 1. Two 100-ohm, 1/2-watt resistors in parallel connected across a 50-ohm cable with near zero lead lengths will be very close to a 50-ohm termination with the SWR less than 1.1:1.

However, adding the diode introduces capacitive loading that results in an SWR of 1.5:1 or more. In the circuit, the components on the 2 dB resistor pad preceding the diode/load compensate for this, as they are tailored to reduce the SWR to less than 1.1:1. Using the simple directional coupler described in my article "Non-Etched SWR Bridge" in the September 1987 issue of *73*, I confirmed the SWR.

Although the power capability of this assembly is 5 watts, forced-air cooling is required at the higher power levels, depending on the measurement period.

The 10 dB Attenuator

See Fig. 2. Inserting the 10 dB attenuator increases power measurement capability to 50 watts. Although it has an attenuation of 10 dB at lower frequencies, at 2 meters and 70 cm, circuit losses increase to 10.8 dB and 12.0 dB, including interconnecting RG-58/U cable losses of 0.4 dB and 0.6 dB, respectively.

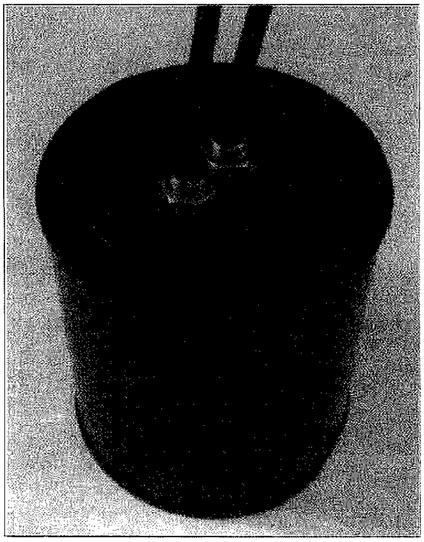


***Photo B.** The 10 dB attenuator.*

Establishing an SWR of less than 1.1:1 at 70 cm was the most critical design consideration. Changes occur with different coolants. If the assembly is tailored for minimum SWR in air, its SWR increases to about 1.3:1 when you put it in vegetable oil. The SWR changes are caused by increased circuit capacitance due to the dielectric. This condition was improved by using household wax, paraffin, instead of oil. *Caution: Paraffin has a relatively low flash temperature; it can be used to make candles.*

Next, to decrease the circuit distributed capacitance, I increased the distance of the components from the circuit board by stacking two layers of PCB at the tie-down pads. This raised the parts connecting positions to about 0.120". The completed assembly has an SWR of less than 1.1:1 at both 70 cm and 2 meters.

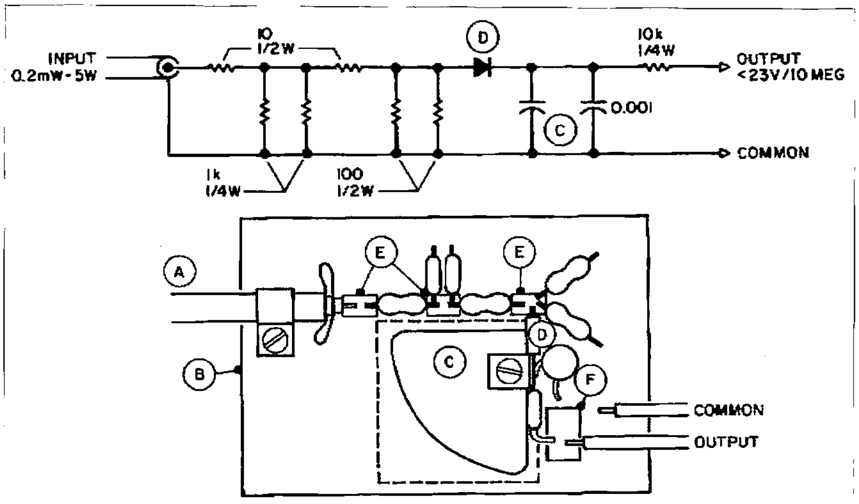


Fig. 1. Schematic and layout of the dummy-load/detector assembly. A. Input, 1' RG-58/U. Fan out braid on connecting end, twist in two segments: solder to PCB with minimum lead lengths. B. Base, 3" x 2" x 1/16" PCB. C. Capacitor. 90 degree circular sector, 1" radius, 0.21"-thick Reynolds sheet aluminum. Surface polish with 220-grit sandpaper to remove burrs. Dielectric, 2.7 mil polyethylene (Ziploc® heavy duty freezer bag). Feed through 2-56 screw with a plastic insulator on the back side. Hole is reamed on both sides with a large drill to prevent shorting to the foil. D. Peak readout diode, 1N34A selected to have a reverse resistance of less than 5 megohms (RS 276-1123). E. Component tie-down pads, 1/4" x 1/8" x 1/16" glass-epoxy PCB. Cemented to base with clear household cement (Elmer's®). F. Output tie-down pad, 3/8" x 1/4" x 1/16" PCB.

Paraffin starts to melt at about 150° F and expands as it melts. You may have a lighted candle on your bench if the components are not immersed in the wax during power dissipation. The container must breathe, and be in an upright position when there is moderate to high power inputs.

The wax may develop voids near the surface when cooling down. Note from the layout that the circuit board is longer than the circuit, forcing the circuit towards the container bottom, away from the wax surface voids. With a 50-watt input, it takes approximately half an hour to liquefy all the wax in a one-pound container.

You can easily calibrate the linearity of the dummy-load/detector assembly with a low-frequency RMS voltage. I use the 60-cycle line with an old step-down transformer and a variac so that I can vary the voltage from about 0 to 50 volts RMS. You can make a 50-ohm source by placing a 50-ohm resistor between the actual output and the transformer AC source (a source impedance of about 5 ohms is considered negligible).

Making Measurements

First, insert the 10 dB attenuator between the 60-cycle line source and the dummy-load/detector assembly. The source is adjusted to a specific diode output value—3 volts, for example. Next, remove the attenuator and note the increased diode output with the dummy-load/detector assembly connected directly to the source. In this case, the value was 9.48 volts. The ratio of the two voltages will be the result of the loss through the attenuator and any change in diode characteristics due to the two different RMS input voltages.

In this example, the 3 volts is about the lower limit before the diode starts a nonlinear rolloff. Therefore, the 3.16 ratio simply indicates the 10 dB attenuator characteristic. As the output voltage is decreased, the ratio will increase: the difference indicates the diode nonlinearity.

Fig. 3 shows a plot of a number of these measurements, with some similar 70-cm measurements for confirming that there are no discrepancies between the low frequency and the 70-cm data. The 5% differences are within measurement error. The easy-to-use table contains the same data. Other 1N34As show reasonable consistency of data. I selected five other diodes measuring 5 megohms or more back resistance and compared them in the dummy-load/detector circuit. All six were compared with the reference diode output adjusted to 0.1 volts. There was only a 10% difference between the low and high values. With 0.5 volt output, the difference was 4%, and with 3 volts, it was less than 1%.

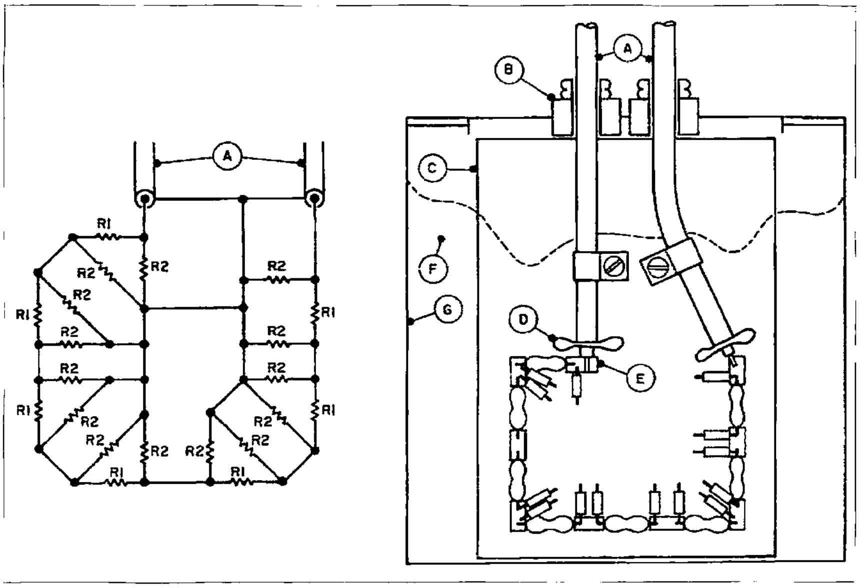


Fig. 2. Schematic and layout of the 10 dB attenuator. R1. 10 ohm 1/2W (7); R2. 1k 1/4W (14). A. Input/Output, 3' RG-58/U. B. Cable bushing, 1/4" clearance hole (I use shaft bushings from old potentiometers). C. Component mounting board, 3-1/2" x 2-3/8" x 1/16" PCB. D. Fan out end cable braid, twist in two segments, solder to PCB with minimum lead lengths. E. Component tie-down pads (9), double thickness glass-epoxy PCB, 1/4" x 1/8" x 1/8. S Pieces cemented together and into position with clear household cement (Elmer's®). F. Coolant, household wax (paraffin). Fill container with melted wax to a quarter-inch from the top. To melt wax, insert the container in hot water (about 200° F). G. Container, one-pint paint can.

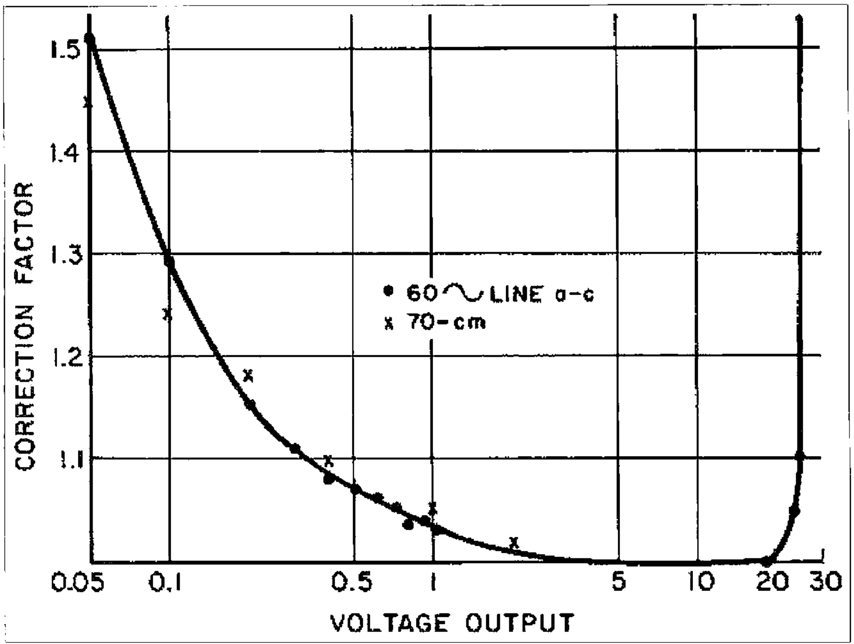


Fig. 3. Diode linearity characteristics (also see Table 1).

The remaining task is to calibrate the dummy-load/detector output as a function of input power. I used a thermal calibration device that's calibrated at a particular power level, then replaced with the dummy-load/detector for a one-point calibration using the identical input power level. The thermal assembly (see Fig. 4) is simply two parallel 100-ohm, 1/4-watt resistors with a thermistor in thermal conduct with the resistors. The layout minimizes thermal mass so that the resistor thermal power results in a relatively rapid temperature gradient.

Testing the device with the SWR directional coupler confirms an SWR of less than 1.1:1. It's first calibrated with DC power input. First, a foam cup is placed over the assembly to prevent effects from possible variable air disturbances. Then power is applied and the thermistor resistance is noted at one-, two-, and three-minute intervals. The resulting thermistor temperature gradient is unique for a particular power input. The assembly can be cooled off to a predetermined reference temperature (near room temperature) in about the same time required for the power-on calibration run by using a forced-air blower. The assembly is calibrated with DC power in increments of 0.25 watts up to 2 watts. See the plot in Fig. 5. Repeated measurements indicate excellent data consistency.

The dummy-load/readout was calibrated using three levels of power: 0.5, 1.0, and 2.0 watts at both 70 cm and 2 meters. From this data, a k value was established for

$$P = \frac{(kE)^2}{50}$$

The k value turned out to be 1.0 at 70 cm and 0.94 at 2 meters, indicating the blackbody/readout assembly has an attenuation at 70 cm. That's 0.5 dB greater than at 2 meters.

To confirm reasonable thermal calibrator performance, I calculated the 2-watt power level with the peak reading from the dummy-load/detector, a 0.707 RMS conversion, and the calculated attenuation of the blackbody circuit (2.1 dB). This calculated power level was 1.0 dB higher at 70 cm and 0.4 dB higher at 2 meters, compared to the thermal calibration method. Such loss factors in with the dummy-load circuit are considered reasonable. As an example, 0.3 dB of this loss at 70 cm can be attributed to the RG-58/U interconnecting cables. Much larger losses would have indicated an input having spurious responses.

You may be thinking: Is this exercise really worthwhile? So I have an SWR of 1.5; calculations show that this will only cause a measurement error of 4%. However, the calculation assumes the effective load, which in this case is 33 ohms (capacitive loading from the diode). It's a common error to assume that the loading stays at 50 ohms. The indicated power level will be 0.64 of the actual power instead of the 0.96 when using the proper load.

Once having the dummy-load/detector assembly calibrated versus a sine wave RMS input, purity of an unknown input can be roughly determined. For example, an input having spurs will indicate an abnormally greater output on the dummy-load/detector compared to the same input calibrated with the thermal

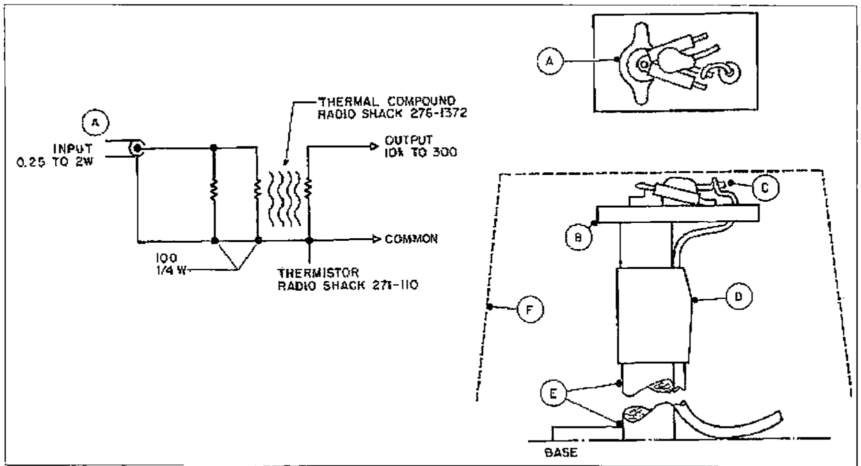


Fig. 4. Schematic and layout of the thermal calibrator. A. Input. 2' RG-58/U. Fan out braid on connecting end, solder to PCB with zero lead length. B. Base, 5/8" x 3/8" x 1/16" PCB. C. Thermistor lead cut short and soldered to a #30 enamel wire. PCB feedthrough hole reamed out with a large drill to avoid shorting to the foil. D. #30 wire connected to a larger size hook-up wire. Fastened to the RG-58/U with tape. E. RG-58/U is fastened to a 6" x 1/4" wooden dowel with tape (maintains the assembly in a vertical position). F. Foam cup is placed over the assembly during the calibration run (avoids air disturbances).

device. The spurs are a good example because they often greatly increase the diode output reading while the thermal power contribution is insignificant.

I'll admit it's hard to get excited about do-it-yourself hardware these days. It's difficult to compete with compact store-bought equipment having all those attractive knobs and buttons. However, I place measurement in a separate category. First, the hardware can be simple. Second, making it yourself forces you to get into the basic engineering underlying the measurement. Taking a measurement using the fundamentals is satisfying, since you end up understanding what is really going on. 73

Output (Volts)		Correct Factor
0.05	x	1.51
0.1	x	1.29
0.2	x	1.15
0.3	x	1.11
0.4	x	1.08
0.5	x	1.07
0.7	x	1.05
1	x	1.03
2	x	1.01
3	x	1.00
18	x	1.00
23	x	1.05

Table 1. Diode Linearity

Letters

Continued from page 31

John Thompson N3KBS. In hopes that you will personally read this letter I want you to know that your October editorial slapped me in the face and said, "Wake up, stupid!" You couldn't have written to me any better if you had mailed a letter to my house. I've ended selling TVs, stereos, and computers at Montgomery Ward and have stopped crying about the lack of opportunity and have decided to make something happen. I've started fixing computers and gadgets and have been successful enough to finance a vacation to Arizona. I've enjoyed several of the books you've recommended. I'm wondering why there hasn't been more use of 900 MHz, which has a lot of room and potential. Thanks for *73*, it's the only ham magazine I've found worth reading. Oh yes, I'm working on losing that extra weight.

Yes, I read my mail. And answer most of it. John, you're right about 900 MHz. I'd love to see a bunch of articles on stuff for that band. . . Wayne.)

Ken Payton KB5ROV. In your editorials you often request letters from your readers letting you know what we have been doing with our time. I find your editorials very interesting and enjoyable because you share your research with your readers and invite us all to join you in reading the same books to gain insight into some subject. I have taken you up on your challenge a few times and am happy to say that I have learned a lot and have had a lot of fun that otherwise I would have missed. For instance: From *Cross Currents*, my wife and I no longer sleep with the electric blanket plugged in. We now use it to warm the bed then unplug it for sleeping. We both feel better for doing this than we thought possible. We have become interested in using magnets for health improvement offered by a company in California. We use some of the magnetic products with positive results. From your *Aids Info* booklet I have built the circuit and we both use it on a regular basis. We use it before going to sleep and find that we rest better. My wife suffers from rather severe cramps at times and has learned that by using this device they are greatly reduced. I have shared your booklet with other people, but have not received any feedback as to whether they use the device. From *Hydrogen Peroxide, Medical Miracle*, I have learned how to cure the common cold. This

Continued on page 51

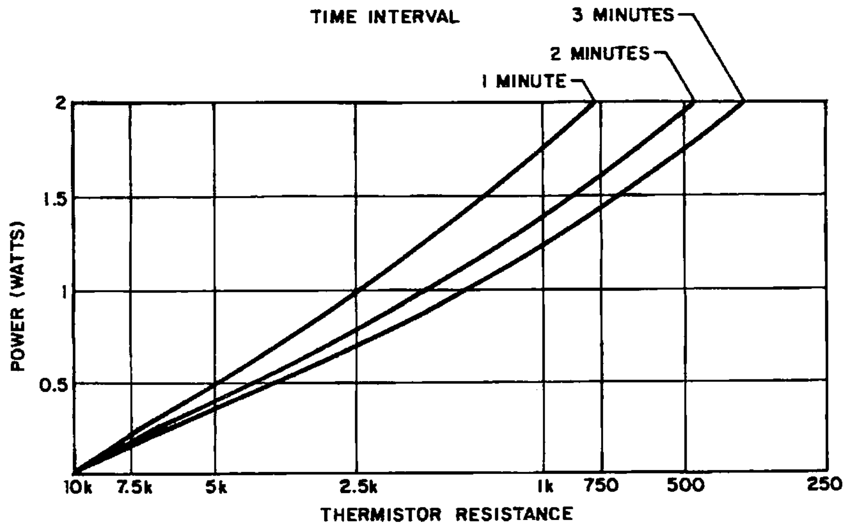


Fig. 5. Thermal device calibration.

Every Ham's Average/Peak Reading RF Wattmeter

The only one you'll ever need.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30
Salinas PR 00751-0030

Ham stations come in all sizes from QRPp to QRO, and most hams like to know just how many milliwatts or hundreds of watts are coming out of their rigs. Until now there has never been a simple, accurate RF wattmeter that is perfect for all legal power levels. The instrument described here will solve all your RF power output requirements, regardless of your power level. Even if you change rigs, going from QRP to QRO or vice versa, you will never need another RF wattmeter.

This wattmeter measures RF power into a 50-ohm resistive load from 100 milliwatts to 1,500 watts in four decade ranges which overlap over 33%, so you'll always know the best range to choose.It can be left in the coax line from your transmitter at all times. It will not affect the impedance of either your receiver or your transmitter. It requires only a small fraction of one percent of your RF output power for operation at any legal power level.

It was designed to use only standard, common components, and can probably be constructed entirely from the contents of most junk boxes and the normal resistors and capacitors most hams keep on hand (or which can be purchased inexpensively from many mail order parts dealers or, for even less, from local hams or at hamfest flea markets).

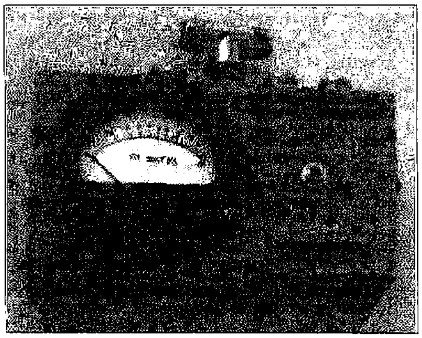


***Photo A.** KB4ZGC's average/peak reading RF wattmeter.*

This instrument is very simple. It's easy to construct in a few hours, very easy to calibrate with a 9-volt battery, potentiometer and DMM, and using it is as simple as glancing at the indication on its meter.

The four power measurement ranges are: 100 mW to 1.5 W; 1 W to 15 W; 10 W to 150 W; and 100 W to 1,500 W. A toggle switch, the only control, allows a choice of average or peak power indication. (Average—actually RMS—power is key-down constant carrier, the actual amount of RF your rig produces. Peak power is that caused by voice peaks on AM or SSB.)

As designed, accuracy is ± 1%, ± the accuracy with which you calibrate the new scale on the meter used. Because the scale is hand calibrated, the normal ± 2% error of normal meter movements is eliminated. Operation is accurate from 1.8 to 30 MHz. It may also be useful through 6 and 2 meters, but I was unable to test on these frequencies.

Circuit Description

Each RF power range has its own coaxial connector: J1-1.5 W; J2-15 W; J3-150 W; J4-1,500 W. A coaxial tee connects the wattmeter in shunt with the coaxial line between the transmitter and the load, which must be 50 ohms resistive if accuracy is to be maintained. One arm of the tee connects to the transmitter, and the other connects to the load.

With switch S1 at AV (average) and the transmitter producing an A1 carrier, the power output delivered to the 50-ohm load is displayed on the meter. The AV position of S1 can be used on all modes.

With switch S1 at PK (peak) while speaking into the microphone of an AM or SSB transmitter, the needle of meter M1 will follow voice power and indicate peak power on voice peaks. The time constant for the peak power mode is approximately 1.9 seconds. Increasing or decreasing the value of capacitor C1 will increase or decrease the time constant, respectively. The resistance of meter M1, plus meter multiplier resistors R1 and R2, in conjunction with the capacitance of C1, establish the time constant.

With an RF input to J1 between 100 milliwatts and 1.5 watts, the RF is rectified by germanium diode D1, filtered by C2, and the resulting DC voltage is applied through R1 and R2 in series to meter M1, which indicates the level of RF power applied to the load.

With greater RF power applied to the load, using any of the remaining coax input connectors (J2, J3, J4 as appropriate), the RF is divided by a ± 1% resistive divider, sampled and rectified at the tap on the divider, filtered by C2/C3, and applied through R1 and R2 to meter M1, as described in the preceding paragraph.

Construction

This instrument was carefully designed to use all standard parts values, which saves cost, time and one's temper. Using a digital ohmmeter for greatest accuracy, begin measuring your stock of 1/4 W 5% resistors and select those which measure to within ± 1% of the marked value. All resistors except R7 are 1/4 W.

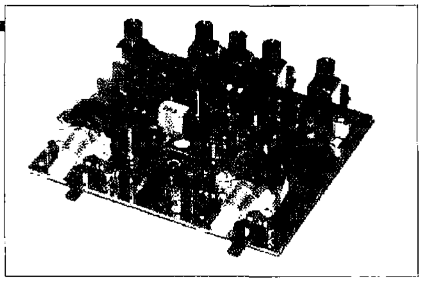
R7 is specified in the Parts List as 1/2 or 1 watt, ± 1%. This resistor will be called upon to dissipate approximately

Continued on page 41

Number 38 on your Feedback card

A Hot, Selective 2m Receiver You Can Have Fun Building

Take a look at the Hamtronics R-100, a great little receiver kit.



Larry Antonuk WB9RRT
Box 452
Marlborough NH 03455

Practically everyone has heard some version of the story. Two hams have hiked up to the top of Mount Something-or-Other, and are viewing all of the impressive towers and antennas at the commercial radio site. The first ham whips out his new Whiz-Bang 2000, a fully synthesized, multiband wonder the size of a cigarette pack. He brings up the 2m repeater back home, and calls his wife on the autopatch to let her know they made the trip OK.

As he begins the conversation, he finds that his wife's audio is choppy, and whole chunks are being lost out of her side of the QSO. Thinking that something must be wrong with the home repeater, the second ham pulls his handheld out of the pack—a 15-year-old, single-channel, crystal rig. To the surprise of both the hams, the older handheld hears the repeater audio loud and clear. It now looks like the Whiz-Bang 2000 must have a problem!

Totally dismayed, the first ham continues to listen to the traffic on the home repeater. It continues to be choppy, erratic, and overall lousy—but the old handheld is doing just fine. Later that night the first ham puts both radios on his test bench, and tests their sensitivity with a signal generator. He finds that they both measure exactly the same; if anything, the Whiz-Bang is just a tad "hotter." What gives?

What gives is that it takes more to pull in a signal than just being able to hear the weak one you want to hear; you also need to be able to *not* hear the ones you *don't* want to hear. In the case of our friends on the mountain, the strong signals from the nearby commercial transmitters were *desensitizing* the first ham's receiver. The signals were strong enough to pass right into the mixer circuits of the receiver and simply overwhelm it, making it impossible for the receiver to hear the weaker distant repeater signal. But how come the old "brick" worked when the Whiz-Bang didn't? It worked simply because the older radio had better selectivity than the newer one, which is often the case these days.

Selectivity

Selectivity is just the radio's ability to reject unwanted signals. These interfering signals can cause problems that you hear in the speaker, or they may remain silent, but prevent you from hearing something you do want to hear. The older radio was designed to work on a fixed channel, and had dozens of coils and caps tuned to just that frequency. All of this hardware made up a set of tuned circuits whose sole purpose in life was to keep out unwanted carriers, harmonics, and spurs—both from outside the radio, and from circuits inside the radio itself. Of course, all of the hardware added to the size and weight of the radio, resulting in the nickname of "brick."

These days, if you want to build a radio the size of a cigarette pack, some compromises have to be made. First, if you expect it to tune from one end of the band to the other without retuning the front end, some of those coils and caps will have to be eliminated. There are some tricks that allow the radio to electronically tune itself, but in general, the front ends of most synthesized rigs are "broad as a barn." In addition, if you want the radio to be tiny, don't expect to put any of those big helical filters and triple-tuned RF stages in the thing—they take up too much space. Generally speaking, this describes most synthesized radios today. They have loads of cool features, but often can't stack up in terms of selectivity.

So what do you do if you really must have the best selectivity? For instance, what if our two hams were up on that mountain scouting out a spot for a new repeater. The receiver in the repeater would have to stand up to the same RF beating that caused the Whiz-Bang 2000 to tuck its tail between its legs. One thing that can be done is to convert a commercial rig to the ham bands, if you have the money. A better option might be to check out the new R-100 VHF FM receiver from Hamtronics.

A Solution: The R-100

The R-100 is the latest product in a long line of high quality receivers built by Hamtronics. Boasting a selectivity specification that exceeds that of most ham and commercial receivers on the market, the R-100 is available in the 50, 72, 144, and 220 MHz bands. Designed to replace the R144/R220 and R76 series of receivers, the R-100 utilizes all of the features that have made the previous units such winners—triple-tuned front end filters, crystal and ceramic IF filters, low noise FETs for the RF amp and mixer. In addition, the R-100 features an improved, snappier squelch circuit, as well as new output signals that will allow easier interfacing to various repeater or control applications—low-level squelched audio, discriminator audio, and a COS point.

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73 Review

The Icom 706
All-Band Transceiver

Reviewed by a very happy user.

Phil Salas AD5X
1517 Creekside Drive
Richardson TX 75081

I recently purchased an Icom IC-706 transceiver to replace my TS-50S for mobile and portable operation. What was wrong with the TS-50S? Absolutely nothing. The TS-50S is a great radio and has provided me many hours of enjoyable "hamming." However, with the sunspots beginning to perk up, I have been seriously considering getting back on 6 meters. I found that a good used 6 meter solid-state all-mode rig would cost me around $500. Therefore, I figured that if I sold my TS-50S and added the $500 the 6 meter rig would cost, I'd have the money for a new IC-706.

The Radio

OK - what is the IC-706? Well, basically it is an all-mode 160-through-2 meter transceiver that is no bigger than most 2 meter FM rigs (dimensions are 6-9/16"W x 2-9/32"H x 9"D, including all projections)! And when I say all-mode, I mean CW, SSB, AM, FM, RTTY. In addition, it will receive wideband FM.

This is pretty neat—you can put it in your car and receive AM and FM broadcast stations, operate 2 meter mobile FM, and operate HF mobile all with the same rig! And, to make it easy to find a place for the IC-706, the front panel detaches from the rest of the radio and can be easily mounted anywhere you've got room. The rest of the radio can be up to 23 feet away (3 meter and 7 meter remote cables are available)!

The IC-706 puts out a full 100 watts from 160 through 6 meters, and 10 watts on 2 meters. The receiver tunes continuously from 300 kHz to 200 MHz. It is also loaded with most of the same features that you normally see in a full-size base HF rig. It includes 101 memories (which is a lot more than my brain has), band and memory scanning, IF shift, RIT, noise blanker, audio speech processor, and an internal keyer.

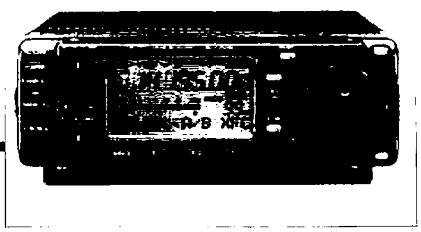
The keyer can be programmed for left- or right-handed paddle users, a straight key, or you can use the UP/DOWN microphone buttons! I found that I could operate the keyer quite well, with a little practice, using the microphone buttons up to about 20 wpm. You can add one optional narrow filter, so you need to choose between a narrow SSB filter (1.8 kHz), a 500 Hz CW filter, or a 250 Hz CW filter. You can vary the CW offset from 300-900 Hz, select a CW reverse mode, vary keyer speed and weight, and offset the SSB carrier plus or minus 200 Hz to tailor the audio response of the transmitter.

Operating

Operating the IC-706 is not all that difficult, considering the huge number of features and the few controls. Icom did an excellent job of building user-friendly menus and displays for accessing these features. Pressing the DISPLAY button brings up major features, and then the MENU button scrolls through subfeatures of the displays. Once you've been through the instruction book once, you should be able to fully operate

P-Out	Setting	Current (160m)	Current (6m)
3.5W	L	5.7A	6.0A
5W	1	6.5A	6.7A
10W	2	7.7A	8.0A
20W	3	9A	10A
30W	5	11A	12A
50W	6	12.7A	5A
100W	H	18A	20A

Table 1.



the radio, only having to go back to the book infrequently. Basic operation of the radio is very easy. About the only thing you need to know is how to change bands, because the default settings pretty much provide you with what is necessary. Just plug in the microphone or key and go! Now, let's get into a little more detail.

Band changing is done with the TS (Tuning Step) button. The first press of this button illuminates two arrows over the 10 MHz/1 MHz portion of the display. When you turn the tuning knob, the bands will change sequentially up or down (includes 15 MHz for WWV). A second push of the TS button puts a single arrow over the 1 MHz portion of the display and permits you to tune 1 MHz at a time. The next button press lets you tune in 1 kHz increments for rapid movement around a band, and the last press tunes in 10 Hz increments for normal tuning. Normally, you punch TS once, change bands, and then punch it three more times to get you back to normal tuning. The radio beeps every time you push a button, so this is a pretty straight forward operation and quickly becomes automatic.

On transmit, you can meter output power, ALC or SWR, based on a simple menu selection. You use the ALC reading to digitally set the microphone gain from one of the menus. The audio speech processor is easily turned on and off and works very well. The output power is continuously variable from another menu from less than 5 watts to 100 watts. My IC-706 turns down to 3.5 watts. This is great for the QRP enthusiast, though the current consumption of this radio is not what QRP-types are used to. Lots of features mean lots of

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Every Ham's Average/Peak

Continued from page 36

one-half watt during 1,500-watt peaks only, so for all practical purposes a half-watt resistor will suffice. Using a 1-watt ± 1% resistor will remove all doubt for QRO operators.

The size and shape of the enclosure you use, either a commercial or home-brew aluminum box, or one made of printed circuit board stock, will depend on the physical size of the 100 μA meter you use and the space required by the four SO-239 or other RF connectors. I used an LMB-138 aluminum box 6-1/2" wide by 3-1/2" high by 2-1/8" deep because my surplus meter was round, with a diameter of 3-1/2-inches. I had to saw about 3/8" off both meter studs so it would fit within the shallow depth of my enclosure.

The four germanium diodes required (D1, D2, D3, D4) must all have the same type number, but it is not necessary to match them for forward resistance.

New 100 μA meters are far too expensive for most of us to even consider. If you don't own one or can't get one from a local ham or a flea market, you can do as I did. The meter I used is 3-1/2" diameter, round, and came in a "grab bag" of five used meters (no choice) purchased from Fair Radio Sales Co., P.O. Box 1105, Lima, OH 45802-1105, Catalog No. 47-84, $10 plus shipping. Over the past 10 years I have purchased seven of these "grab bag" assortments, and all meters have been high quality, with d'Arsonval movements, some with jeweled bearings, made by Marion, Westinghouse, Simpson, etc. Size varied from 2-1/2" to 6"; round, square and rectangular. All have been removed from equipment and tested before resale. While meter scales are sometimes non-standard, there have always been at least one, and often two, meters with 50 or 100 μA movements. The remaining meters have always had 0-1 mA movements.

Some meters may contain internal multipliers or shunts and sometimes rectifiers, but these are easy to locate and remove. If you have such a meter and are unfamiliar with modifying meters, please refer to my article, "Use Those Surplus Meters," *73 Amateur Radio Today*, January 1992, page 42. You can order photocopies from the publisher if you don't have a set of back issues on the shelf (tsk!). All in all, for $2 you'll have a fine 100 μA meter for your RF wattmeter, and have four more useful meters for future projects.

It will be preferable if all four coaxial connectors are mounted touching each other, either in a line or square. This allows for very short leads for all components carrying RF, extremely important to achieve the design accuracy. There is always some unavoidable RF leakage which will be contained by the enclosure, but which forces a deviation from the calculated resistance values to maintain the accuracy of this instrument.

The four coaxial connectors should be mounted using four sets of 4-40 screws, lock washers and nuts. Be sure to scrape any paint from areas where these connectors are mounted, to assure excellent grounding to the enclosure. Two terminal strips with one ground and one insulated terminal will later be mounted using two of the connector mounting screws, depending upon the arrangement of the connectors.

Wrap a fine wire around both terminals of the meter M1, shorting them together to protect the sensitive movement. Then mount the meter on the panel temporarily. It will be removed for calibration, then replaced and connected into the circuit permanently. Temporarily mounting the meter now ensures there will be no components or wiring which would interfere with the meter case or terminals.

Cut one lead of R3, R5 and R7 to 3/16". Hold the short lead of R3 close to the resistor body with the tip of needle-nose pliers. Melt solder into the center pin of J2. When the solder is molten, insert the short lead of R3 into the molten solder, making certain not to move it while the solder solidifies. This is no place for a cold solder joint!

Repeat this procedure, soldering the short lead of R5 to the center pin of J3, and the short lead of R7 to the center pin of J4.

Now mount the two terminal strips on connector mounting screws, positioning the terminal strips so their terminals are approximately centered below and between J1 and J2, and between J3 and J4. Tighten the mounting hardware, using additional lock washers if required.

Because of the necessity to reduce to the greatest extent possible the chance that any RF can leak off where it isn't

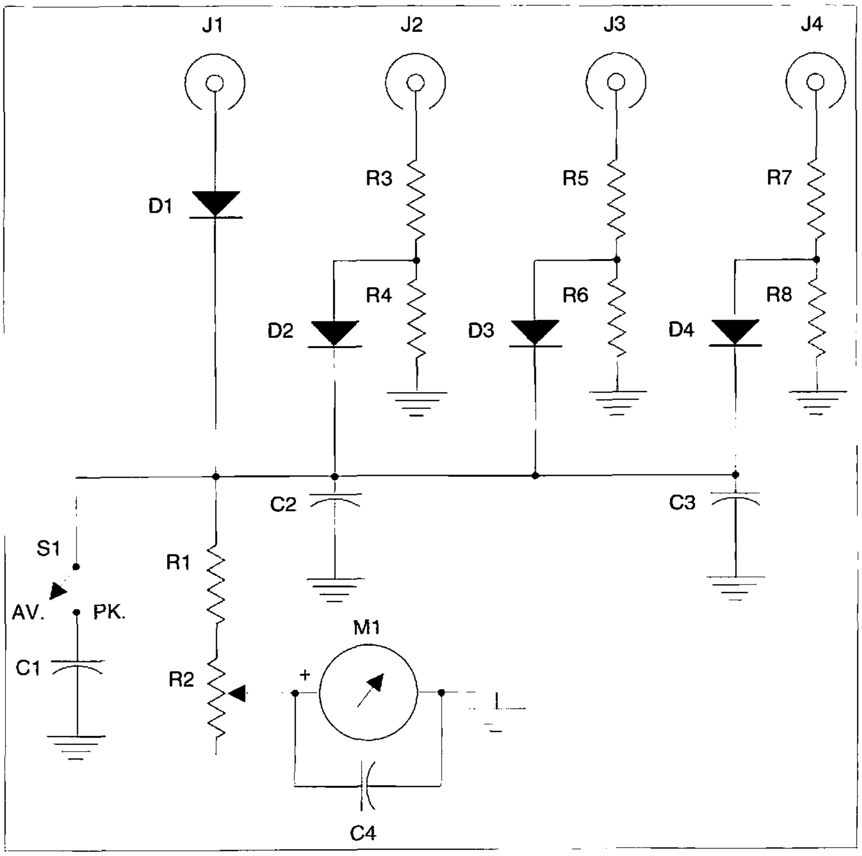


Fig. 1. Schematic for the RF wattmeter.

wanted, thus destroying the accuracy of this instrument, connections to the free ends of R3, R5 and R7 must be made "up in the air," spaced away from the enclosure walls and the meter movement. If space requires, J1 can be safely mounted near the meter, but the others should be some distance from the meter.

Now solder one end of R4 to the free end of R3, against the body of both resistors. Clip the end of R4 at this junction but leave the free end of R3 attached. Route the remaining lead of R4 to the ground terminal on the appropriate terminal strip, but do not solder it at this time. Make sure the soldered junction of R3 and R4 is "up in the air" and in the clear. Now, using needlenose pliers to hold the anode of diode D2 close to its body, connect the anode lead to the junction of R3 and R4, and solder. Clip the extending leads of R3 and D2. Route the cathode lead of D2 to the insulated terminal of the strip to which R4 has been connected, but do not solder yet.

Cut the anode lead of D1 to 3/16". Hold this end of the lead in the tip of needlenose pliers. Melt solder in the center pin of J1. When the solder is melted, insert the short anode lead of D1 into the center pin of J1 and hold it steady until the solder has solidified. Continue holding the diode anode lead with the needlenose pliers until the solder joint is cool, to protect the diode from excessive heat.

Route the cathode lead of D1 to the insulated terminal to which the cathode

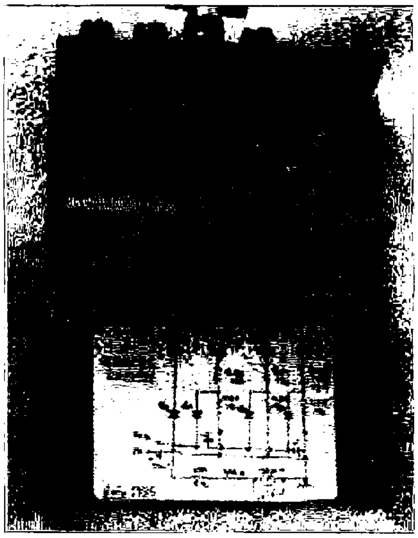


Photo B. Inside the RF wattmeter.

lead of D2 has been connected, but do not solder it yet. Connect a short length of insulated hookup wire to this insulated terminal. Solder this wire and the two diode cathode leads on the insulated terminal using an alligator clip or needlenose pliers on both diode leads to protect them from excessive heat. Connect the other end of this wire to the insulated terminal on the other terminal strip. Solder the lead from R4 on the grounded terminal strip. Solder C2 between the holes on the insulated and grounded terminals. C3 can likewise be soldered between the holes on the two terminals on the other terminal strip at this time.

Connect and solder one lead of R6 to the free end of R5, routing the free lead of R6 to the grounded terminal of the other strip, as was described for the circuit connected to J2. Connect the anode lead of D3, holding it with needlenose pliers, to the junction of R5 and R6 as described for D2, and solder. Clip free resistor and diode leads from the R5-R6 junction. Route the diode cathode lead to the insulated terminal of the remaining terminal strip but do not solder.

Connect and solder one lead of R8 to the free end of R7, routing the free lead of R8 to the grounded terminal of the strip where R6 is connected. Solder this connection. Clip off the free excess lead of R8 at its junction with R7. Holding the anode lead of D4 with needlenose pliers, connect and solder to the junction of R7 and R8. Clip off the excess diode lead. Route the cathode lead of D4 to the insulated terminal where the lead from D3 is connected. Connect a short length of insulated hookup wire to this insulated terminal. Using an alligator clip or needlenose pliers on the diode leads, solder this terminal.

Closely inspect all solder joints just made to ensure they are shiny and all connections are solid. If necessary, gently move the three resistor/diode circuits so their junctions are "up in the air" and away from each other and the walls of the enclosure.

Caution: Before any further construction can be accomplished, meter M1 must be calibrated. Refer now to the calibration section following. When calibration has been finished, return to this section to complete the construction.

With calibration completed and the meter reassembled, mount the meter on the panel. Select a small terminal strip with two insulated terminals. Connect R1 between the terminals but do not solder yet. Mount the terminal strip on one of the meter mounting screws, using additional lock washers if required.

Connect the wire leading from the terminal strip which ties all diode cathodes together to one end of R1 and solder. This wire carries only low voltage DC but should be routed away from the resistors carrying RF. Its length is immaterial.

R2 is a trimpot. Because they are made in various configurations it is up to you to determine how to install the one you use. I used a small, square trimpot, single turn, with a side adjustment. I used Krazy Glue® to attach it to the rear surface of the meter.

Solder a length of insulated hookup wire to the free terminal of R1. Solder the other end of the wire to either of the end terminals of R2. Solder another length of wire between the wiper terminal of R2 and the positive terminal of M1. Solder a wire between the negative terminal of M1, to a ground lug mounted on either a meter mounting screw or one of the screws mounting the nearest coax connector. Connect and solder C4 across the terminals of M1.

If you are including the peak reading capability in this instrument, mount switch S1 and capacitor C1. Be certain of the polarity of C1. Connect a short length of insulated hookup wire from the free terminal of S1 to the terminal where R1 and the wire from the diode junctions are connected, and solder.

There are three short tests which should be made before closing the case. Place S1 in the AV position. Attach the 50-ohm dummy load which you normally use in your station to J2. Using a digital ohmmeter, measure the resistance to ground from the junction of R3/D2/R4. Be certain the red (positive) lead goes to this junction. The resistance should be in the vicinity of 2,385 ohms.

Connect the 50-ohm dummy load to J3 and measure from the junction of R5/D3/R6 to ground as described above. The resistance should be in the vicinity of 3,140 ohms.

Connect the 50-ohm dummy load to J4 and measure the resistance from the junction of R7/D4/R8 to ground as described above. The resistance should be in the vicinity of 1,111 ohms.

The resistances just measured bear little relationship to the values of R4, R6 and R8. This is because of the several parallel resistance paths inherent in the design of this instrument. These values are for guidance and are not intended to be exact; merely close. The tolerances of the ± 1% resistors, the forward resistance of diodes, and the exact resistance of the 50-ohm dummy load all affect the resistances just measured.

Calibration

Because the root-mean-square value of an AC voltage (RF) waveform represents the effective voltage across a resistance, this instrument can be easily calibrated with a variable DC voltage. Less than 9 volts is required, so a 9-volt battery and a potentiometer is the simplest calibration source, along with a DMM for accurate voltage measurements. The overall measurement accuracy is greatly affected by the care with which the meter is calibrated by hand.

Remove the meter from its case so you have access to the face. If there is a scale, the numbers and calibration lines can be carefully covered with a product such as Liquid Paper® (used for making corrections in typed material). Use it sparingly, and be careful not to obliterate the arc. Use care not to bend the needle! You may wish to remove the meter face to make this work easier. The face will have to be replaced on the meter before calibration can proceed.

Refer to Figure 2, the calibration setup, and make the connections between a germanium diode, R1, R2, M1, the calibration potentiometer, DMM and a 9-volt battery.

Set R2 to its maximum resistance, and also set the calibration pot to its minimum resistance with its wiper at the negative end before connecting the battery. You may also use any other DC voltage source handy, including the station power supply, of course.

Table 1 lists the 15 voltages required to calibrate the meter scale between 1 and 15. The more accurately you establish these voltages and the care with which you mark each point on the new meter scale, the greater will be the overall accuracy of this instrument. Although this is of major importance only to QRP and QRPp operation, it will still be nice to know that "What you see is what you get" when you glance at the meter later.

Adjust the calibration pot so the DMM indicates 8.66 volts. Then adjust R2 for a full-scale indication on M1. Mark this "15."

Caution: Do not touch the setting of R2 after this initial calibration is made. Adjust the calibration pot so the DMM indicates 8.37 volts. Mark the meter needle location on the scale "14."

Referring to Table 1, continue marking calibration points on the meter scale with the numbers equivalent to the calibration voltages listed.

It will be preferable if you merely make tick marks on the meter scale during calibration. You can extend them into short lines and add the numbers when calibration is complete. The larger the physical size of your meter, the easier and more accurate will be the calibrations. Because the scale is nonlinear, the higher power calibrations will be more crowded than those at the lower end. Also, only about 2/3 of the available scale is calibrated so that 1-1/2 decades can be covered on each range, providing the desirable overlap between ranges.

Because "1" on the 1.5-watt scale represents 100 mW, QRPp operators may be tempted to calibrate their scale below this point. However, this is not recommended because of the approach of the low RF voltage level to that of the germanium diode conduction knee. Serious inaccuracies could result.

Operation

The operation of this RF wattmeter is simple. Connect a coaxial tee adapter to the appropriate connector on the wattmeter. Connect the transmitter output to one leg of the tee, and a 50-ohm dummy load sufficiently robust to dissipate suspected transmitter power output to the other leg safely.

Key the transmitter and the power output will be indicated by the wattmeter. With an antenna or an antenna tuner and antenna presenting an SWR of 1:1 connected replacing the dummy load, the wattmeter will accurately indicate the output from your transmitter.

For modes other than AM or SSB, S1 will normally be set at AV. The PK position is included to monitor peak power on AM and SSB. With S1 at AV and operating AM or SSB, the wattmeter needle will swing wildly but the peaks indicated are the result of inertia and do not accurately display actual peak power.

Should you inadvertently apply power to this instrument without a 50-ohm resistive load connected, you might blow a diode, and you might bend the needle in a worst case, but no other damage should result. So, make certain you connect to the proper connector on the wattmeter. If you are unsure of the power output from a particular transmitter, start at J4 and work your way down.

Comments

Although the resistance tolerances of ± 1% are specified for resistors in the RF portions of the circuit for greatest accuracy, especially at the QRP range of 1-15 watts, the QRPp accuracy is totally a function of the accuracy of the calibration voltages and the care with which the meter scale was marked. The inaccuracies resulting from the use of 2% or even 5% resistors on the 150- and 1,500-watt ranges are much less important. A watt or two at these power levels is inconsequential, so you can fudge a little on these two highest ranges without being very concerned.

Peak power indications can be made usefully only on those modes where the output power actually varies. It is of no

Continued on page 57

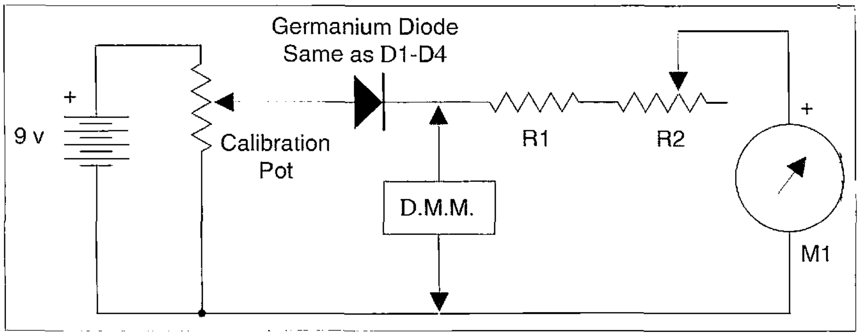


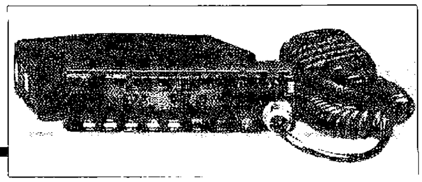
Fig. 2. Calibration setup.

Number 46 on your Feedback card

73 Review

The Alinco DR-610T

A tough new dual-band, remote-head mobile/base transceiver.



Gordon West WB6NOA
2414 College Drive
Costa Mesa CA 92626

What could Alinco Electronics do to top what the rival "big three" have done with a detachable-head, 2 meter/440 MHz, mobile transceiver? It's tough to surpass all of those great features already found in the Kenwood, Yaesu, and Icom versions of this product. The new Alinco DR-610T has these same features, too:

•High power, 40 watts-50 watts on 2 meter VHF
•Moderate power, 35 watts out on UHF
•Full frequency receive coverage VHF, 108 MHz-173 MHz
•Full frequency receive coverage UHF, 420 MHz-470 MHz
•100+ memory channels between both bands
•Multiple scan functions, including priority
•Monoband dual-receive
•CTCSS encode
•Multiple output levels
•Remote detachable head
•Crossband duplex, 9600/1200 bps packet compatible
•Time-out timer
•Phone patch auto dialer

However, the Alinco DR-610T may top the competition when it comes to an extremely important feature for ham operators wanting maximum value at the best price—the DR-610T was seen selling for at least $85 less than comparable Kenwood, Yaesu, Icom, and Standard Radio dual-band transceivers. The DR-610T is also the first dual-band transceiver with built-in LITZ, "long tone zero." This function, described in a *QST* article several months ago, may soon be one of the best ways to signal for help on simplex or repeater duplex frequencies late at night when the control operators may have their equipment in the automatic unmonitored mode. The LITZ signal is accomplished by holding the "zero" DTMF button down on "transmit" for more than three seconds to alert another Alinco DR-610T, or any other system with LITZ capability, that an important message is on frequency. When a DR-610T receives a LITZ signal, it will sound a loud SOS CW alerting tone, regardless of the speaker's volume setting, and flash a "LIT" on the LCD display to alert you that an incoming three-second zero has been detected. This feature allows a control operator and all hams to monitor (silently) a specific frequency at night for an "SOS" LITZ call.

"The built-in LITZ feature allows a control operator and all hams to monitor (silently) a specific frequency at night for an "SOS" LITZ call."

Alinco President Mark Morisato describes the DR-610T as "designed for convenience, with advanced operating circuitry already built in." He is describing the LITZ function, built-in duplexer, digital squelch circuitry, and capabilities for adding an EJ-23U memory chip to program a whopping 240 channels in fail-safe memory. Dave Chernow KE6TFO, sales coordinator for Alinco, adds, "Our DR-610T is an upgraded success based on our DR-600, which continues to be one of the hottest-selling dual-band mobile/base transceivers throughout the country."

The DR-610T is shipped with one of the most complete large-format instruction manuals that I have seen for some time. Read the manual before turning on the equipment—this will save you agonizing minutes when you get into keystrokes that appear to freeze channel-changing capabilities. The set is no more complex to operate than any other brand of transceiver but, as with all new equipment, you *must* read the first couple of pages to get a feel for how you program frequencies and begin to memorize simple and duplex channels.

The Alinco DR-610T wires into 12 volts, and needs 12 amps for full power output. Yes, you could run it straight off a cigarette lighter plug, but we measured a 1-1/2 volt drop, and this decreases VHF/UHF power output by more than 10 watts. If you want to squeeze every last drop out of your new set, wire it directly to the battery, making sure to fuse both the positive and negative leads within an inch of the battery connection. Alinco provides you with the fuses and fuse holders at the ends of the red and black wires.

The DR-610T has a built-in duplexer, and this simplifies the hookup to your dual-band antenna. Whether you are running the equipment mobile or base, a single coax feed makes for quick hookup to the single antenna system. Few of us use separate 2 meter and 440 MHz antennas, so run your coax, hook into the antenna system, and you are all set.

Optional Features

If you're going to remote-mount the head, you will want to buy the EDS-2 front panel remote cable kit, and the EBC-8 front panel bracket. You could

also order the EDS-1 junction box that allows the microphone to hook up to something beneath your seat, rather than off the remote head that you may want to put over the rearview mirror. Many new vehicles come with capabilities for running the remote up high, and the junction box keeps the microphone from dangling in front of you.

I would also encourage you to purchase the optional tone decode squelch unit EG-24U, which would allow you to radio-control the operation of your equipment from another hand-held transceiver. This is a handy feature if you regularly run your mobile unit in the crossband duplex mode and want to radio-control it on or off, or to change frequencies by remote. Whenever running equipment in the dual-band crossband mode, check with local frequency coordinators to ensure that you are using this advanced feature properly, and remember that controlling a "repeater" must be done on frequencies other than its normal input.

And as long as you are inside the set, you might as well purchase and plug in EG-23U, the additional memory unit that expands your 120 channels to 240 channels. Now you can program every living repeater, aeronautical receive channel, public safety channel, weather channel, police and fire channel, and just about anything else you want, into memory so you never need to carry that little black memory book with you again!

The full-featured EMS-12 microphone is shipped with the USA model. No longer must you buy a more elaborate microphone to go along with all of the dual-band capabilities for which you are programming the set. The microphone is relatively lightweight and has its own unique Alinco feel. I have friends who have tried out the equipment and have immediately fallen in love with it.

Operation

When everything is hooked up, turn on the power by depressing the power button located just above the mike jack. Like all dual-band transceivers, it comes up in VFO mode at 145 MHz for 2 meters, and 445 MHz for the 70 cm band. There is nothing loaded into memory. You know, with CPU technology and cloning, I wish that incoming transceivers would have the US repeater band plan stored. Which manufacturer will be first to pre-load common popular repeater pairs so the new operator can go into memory and start receiving radio excitement on 2 meters and 440?

"When it comes to group pager modes, selective calling, all calling, and group calling, Alinco has moved well ahead of other manufacturers in providing documentation and explanation in their user manual."

Unlike the Yaesu FT-8500, the new Alinco has no cloning capabilities nor does it offer alphanumerics user-programmable on the display. But it is not as expensive as the Yaesu set, either!

The LCD display on the Alinco looks very good, and is easily viewed from the top, bottom, and sides. Volume controls for both VHF and UHF are side-by-side, and you have plenty of volume output for use in noisy vehicles. The squelch control is logically concentric to the volume controls, and squelch action is normal for this type of transceiver. Signals just in and out of squelch will chatter, and this is typical of "hard squelch" found in almost all equipment except for some Icom transceivers that use a new soft squelch feature.

You select VHF or UHF by pushing the volume control in for that particular band. You can dial the frequency from the front panel knob, or push the microphone up/down keys, or program the frequency from the microphone. The big channel-changing knob on the front has a logical push capability to enable 1 MHz quick-steps. This allows you to rapidly go from ham to public service without having to fish around to find the 1 MHz button—a good feature.

The transmit power was 52 watts on VHF into a perfect match, and 37 watts on UHF. A small fan comes on immediately to keep things cool. An LCD bar graph illustrates high power, medium power, and low power. However, the LCD graphs don't change much with a major antenna mismatch. On older single-band and dual-band transceivers you could always tell a bad match by a power output indication that never makes it to the top. It would probably be wise to check your VSWR initially with an external meter before pouring on the coal.

Dialing in the VFO mode is a snap. Getting down to the AM aircraft band requires just a couple of button pushes. We found half-microvolt sensitivity from aircraft band all the way up through 170 MHz on VHF, and one-quarter-microvolt sensitivity on UHF band limits, too. We drove the unit through "intermod alley," and it was no worse than other dual-band mobiles we have tried. This is a major improvement over the Alinco 599, which had such a hot receiver that it was prone to intermod. A built-in attenuator of about 20 dB can be placed in either, or both, VHF and UHF bands when you have plenty of signal to work with and you want to knock out intermod. A very small "ATT" icon appears above the frequency display to show the attenuator turned on.

The Alinco DR-610T features 120 memory channels plus split channels, call channels, and scan edge channels. They are divided into five banks. Bank A, B, and C memory channels are used for both VHF or UHF. The same memory channel can be recalled for both VHF and UHF. Thirty channels are dedicated to VHF, 30 channels for UHF, and 20 per Bank A, B, and C (total of 60) can share bands. The shared bank is an advanced feature, and most hams will start off with either VHF or UHF by themselves. To memorize a VFO frequency in a specific memory, you would push the "function" button, then the bank button, then dial up the frequency you want, and push the "MW" button while the function symbol is showing. While this sounds a bit confusing, it begins to make sense after you have programmed a couple of channels. I would say it's no harder to program this set than any of the others, once you read the manual and follow the steps precisely.

We tried the "spectrum analysis" feature, also found on an Alinco handheld, and indeed little LCD bar graphs go up and down as adjacent-channel and on-channel activity come up and go away. But it's not real-time, and there is an annoying "hiccup" each time the unit samples the MPU looking to see what's happening on other frequencies or channels. I would view the spectral display as a specialized feature that only a few hams will truly take advantage of. It's not the same as looking at a spectrum analyzer.

The Alinco goes into single-band transceive easily, eliminating the band you don't want showing on the screen. This is a handy way to make programming easy for you when you're on the road and you're just listening to a single band. When checking repeaters for input activity, you will feel for the second button in on the bottom (the reverse button), and give it a push. While this is a great feature, I wish they had put the reverse button as a double push of the main tuning button.

The CTCSS built-in encoder was straightforward. However, why no decoder? The new little Radio Shack single-band mobile offers both encode and decode. Other manufacturers leave out decode, too, so it'll probably be awhile before we get encode/decode as a built-in feature.

The unit can easily go into the "set mode" to allow the following menu selections: beep tone volume, bell audio on/off, speaker on/off, display back lighting, time-out timer, channel scope receive interval, channel scope kilohertz width, DTMF first-digit delay, DTMF burst and pause interval, LITZ on/off, monitor function on/off, and S-meter squelch on/off.

Crossband capabilities? Yes—a great feature. Unlike earlier models that required internal modification, the new DR-610T has full crossband capabilities. You would only use crossband with the optional CTCSS decoder installed and set. If you don't, random noise could trigger your crossband receiver to unsquelch, causing the transmitter to lock on, and a signal containing nothing but hash to go out on the air. If you only use crossband duplex with CTCSS decode, the only thing that will trigger your transmitter is a proper signal with a proper tone. It would also be good to enable the time-out timer to cycle the whole system down in case something should hang up the transmitter.

If you have the built-in tone decode unit, you can control your transceiver using a DTMF companion hand-held or mobile set. Number 45 starts accepting remote-control commands, and number 54 stops the remote-control commands. D1 turns the crossband repeater on, and D4 turns the repeater off. You can allow direct frequency entry up to five or six digits in the external remote-control mode when working frequencies or memory channels in crossband. We recommend that you contact your local VHF and UHF frequency coordinators before enabling this unit as a base station in the crossband remote.

Packet operation of the Alinco DR-610T can be a normal TNC at 1200 bps, with an input of 2.7k ohms and a normal modulation input of 10 millivolts peak to peak. For 9600 baud, the input is 10k ohms at 2 volts peak to peak with a TNC that can handle this faster rate. The Alinco crew offers several pages on typical packet operation hookups, and we judged the diagrams as very good.

When it comes to group pager modes, selective calling, all calling, and group calling, Alinco has moved well ahead of other manufacturers in providing documentation and explanation in their user manual. Few hams ever use the group pager mode, though it's a very handy feature to alert one person, groups of 10, or groups of 100 that something is happening out there on the airwaves. The pager mode requires the optional tone unit for decoding, but the auto-dial mode that is part of the basic unit allows encoding any tones that you wish to send out. There are seven digits in the total group pager mode. Wild-card tones can alert many stations at the same time of incoming traffic. I suggest that emergency communications team leaders help everyone set up for this very important mode for disaster preparedness. Most sets have this group-call capability with the optional decode chip, and it is indeed a very functional—albeit complicated— operation.

The DR-610T is best suited for small-vehicle use. You would want that detachable head right in front of you, and you may wish to remote-connect the microphone so you can get your big fingers around those very tiny volume and squelch knobs. The tiny buttons and the tiny volume and squelch knobs have almost exceeded the demands of miniaturization for most of our radio users. Several users mentioned that the buttons and knobs were too small for heavy-duty mobile use. However, the DR-610T's performance was extremely impressive when it came to solid power output, cool-running transmitter, and plenty of receive audio for noisy vehicles. The display was relatively small, but very viewable both day and night as it is back-lit.

If United States amateurs embrace LITZ, it will be a boon for travelers, who will be able to signal for help or roadside assistance by simply holding down the zero button while keying the mike for more than three seconds.

Best of all, the new Alinco DR-610T is probably one of the lowest-priced dual-band mobile transceivers, with more than enough features and memory channels than you'll probably ever use. But it's nice to know you have a transceiver that will grow with how you plan to use it. For the best deal, get those internal chips at the same time you purchase your new set. Plug them in, and get set for a power-packed dual-band transceiver that is just as much at home at your base station as it is under the dash or above the rearview mirror in your car. I liked the Alinco DR-610T.

73 Review

How About a 2W 40m Transceiver Kit?

Build a "fits-in-your-pocket"40m QRP transceiver.

Photo B. The completed rig.

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Cookeville TN 38501

Club Project

The Wilderness Radio NorCal 40A was originally a club project of the Northern California QRP club. The club wanted a project that would really spark interest in QRP. Jim Cates WA6GER, Doug Hendricks KI6DS, and Wayne Burdick N6KR, the club's organizers, got together to discuss a possible club project. Their philosophy was that if they could come up with a small QRP CW transceiver that was easy enough for the new builder, yet performed well on the air, they would have a new breed of low power enthusiasts. The word about the new kit spread rapidly in QRP circuits and the newly formed NorCal club grew to over 1,500 members in just over two years. The success and growth of the club can, in a great part, be attributed to the club projects. The club also publishes an excellent magazine called *QRPp*. Bob Dyer KD6VIO recently started Wilderness Radio to offer the NorCal 40 commercially to all those who missed out on the club's offering. Bob is now offering this kit and other excellent NorCal QRP kits.

How QRP Is It?

Wayne Burdick N6KR designed the kit for the club. The NorCal 40 was designed to be a compact 40 meter CW transceiver optimized for portable, battery-powered operation. The rig has very low receive current drain, typically only about 15 mA. It is also very thrifty on transmit. The rig has RIT (receive incremental tuning), very smooth and quiet transmit/receiver switching, a very pleasant sidetone, and the power can be adjusted internally from almost nothing to a maximum of between 1.8 and 3.0 watts, depending upon the supply voltage.

I have had many new hams ask for advice on what type of kit to start with, so I've established some basics that are the key to any successful venture into this area. It should be easy and fun to build. This means the directions have to be clear and easy to follow. The printed circuit board needs to be of high quality and clearly silk-screened so you know which parts go where. I prefer plated-through solder-masked boards. They are much easier to solder: the solder joints are stronger and the solder mask helps eliminate one of the two major building errors that new kit builders frequently run into: putting the wrong part in the wrong place or ending up with a solder bridge on the board. (A solder bridge is where you accidentally get solder to connect two parts of the board that aren't supposed to be connected.) Clear instructions and a good silk-screen help eliminate the wrong part problem and the solder mask helps eliminate the solder bridge problem. The Wilderness Radio kit has a top-of-the-line, nicely silk-screened, plated-through, solder-masked printed circuit board and good instructions.

The next area that new kit builders are concerned with is tuning up the rig. This kit was designed to be easy to align and it can be done with no test equipment. If you don't have test equipment, such as an oscilloscope and frequency counter, you can use an HF transceiver.

VFO-The Way To Go

New builders are usually looking for inexpensive kits. While separate transmitter and receiver kits are available, if new builders don't choose kits that perform well they can easily get discouraged. I always recommend a transceiver over separate transmitter/receiver combinations. I also recommend a superhet receiver with a VFO rather than a crystal-controlled kit. It may be fun for a

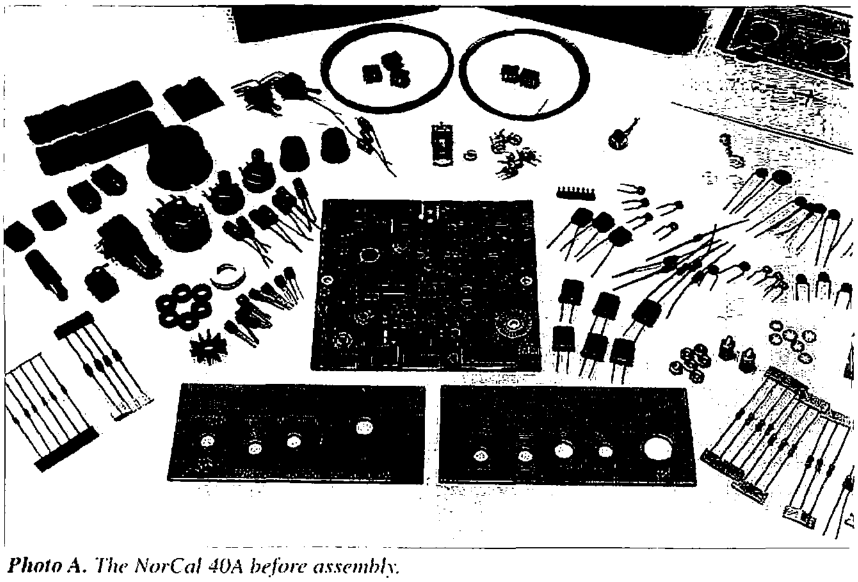

Photo A. The NorCal 40A before assembly.

LETTERS
Continued from page 35

really works! From *Amazing Mind Machines You Can Build*, I have improved my use of the Pendulum and had a lot of fun with it and the Energy Wheel. I then built the Wishing Machine, using the block diagram and a Radio Shack Mini Amplified Speaker #277-1008C as the active circuit. By following the author's suggestions I have helped a good friend who is suffering from prostate cancer. He is taking chemotherapy, but is not experiencing any of the usual illness that is associated with this treatment. His improvement since using the Wishing Machine has been nothing short of fantastic. I have enjoyed studying from these books and plan to add to my library on a regular basis. Keep up the good work. There are many of us who really enjoy your editorials and benefit greatly. Thanks.

You're welcome! But Ken, how about letting me know what books you've found that I might enjoy?... Wayne.)

Richard Harrison KB5WZI. My father-in-law, Phil Rand W1DBM, recently became a Silent Key. Phil was born in 1906, the son of a founder of Remington Rand Corp. He was a registered engineer, inventor and prolific author. For instance, among his WWII contributions was a TV-guided bomb. An avid ham, his first *QST* articles appeared in 1930. He finished his final

Continued on page 61

short while to operate some of these kits, but I found the fun ran out quickly when I was stuck on a single frequency.

The NorCal 40A has a superhet single-signal design receiver which has excellent sensitivity (it hears the signals if they are there), selectivity (it can separate the signals), good audio output, and an AGC circuit (automatic gain control to attenuate very strong signals and keep the audio more constant). The VFO (variable frequency oscillator) is very stable.

Physically, the rig is very small (2.25" H x 4.5" W x 4.5" D). One double-sided, screened, and plated-through PC board is used. There is *no* chassis wiring: All controls and connectors and even the case parts themselves mount directly to the board, resulting in a much easier final building stage. The custom .060 case is extremely rugged and is designed to allow the top and bottom to be removed easily for alignment or testing. Long-life plastic latches are provided on the top so no screwdriver is needed to access internal controls. If you like to play with the tune-up every once in a while, or just show off your work, this is great. The rig is small enough (one of the smallest on the market) to fit easily in a backpack. I power mine with a pair of small gel cells that keep it going for a long time.

After building about every kit on the market, it amazes me that this design was originally a club venture. It was so successful that they had to do multiple runs of the kit, selling them all over the world.

Accessory Keyer/Counter

The Wilderness Radio NorCal 40A is revision B. The AGC performance has been improved. A low-pass filter has been added after the VFO to improve receiver image rejection by 10 dB, and improving the AGC and transmit/receive switching for better attack/delay times and reduced audio thumps. The case has nifty plastic latches and the chassis is supplied in a beautiful blue painted and silk-screened combination. Even though the cabinet is small, there is still room for the more advanced ham to play with added accessories such as small keyers.

One of Burdick's latest kits is also being offered by Wilderness Radio. This is the KC1 keyer/frequency counter. It is a small iambic keyer with 54 bytes of message memory and a displayless frequency counter that reports the frequency in Morse code. There is room

Continued on page 75

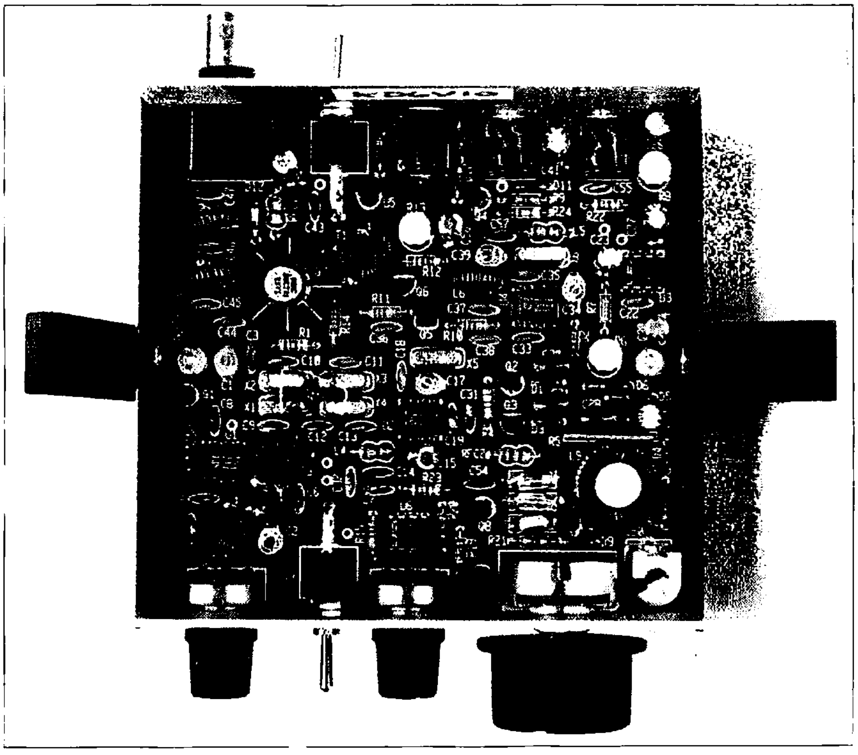

Photo C. Inside the completed unit.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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It's here! After many months of anticipation, and quite a bit of work behind the scenes, the RTTY Loop Home Page is now available on the World Wide Web. While this column, running in the pages of *73* for more than eighteen years, has reached countless numbers of radio amateurs, the potential audience for the Loop on the Web is virtually unlimited.

To access the RTTY Loop Home Page, point your net browser to: http://www2.ari.net/ajr/rtty/ and the home page will be displayed. Fig.1 shows what you will see:

From the home page, you may jump to a full text of the current column, a listing of the software available in the RTTY Loop Software Collection, a download section for current or special software, and a page of links to other interesting sites. The column text is wired with hyperlinks to mentioned sites, so that clicking on a site's name described in the column will take you to that site. I will also try to make recent software mentioned in the column available for download, through the download section, as well as provide for any more specialized requests, if possible.

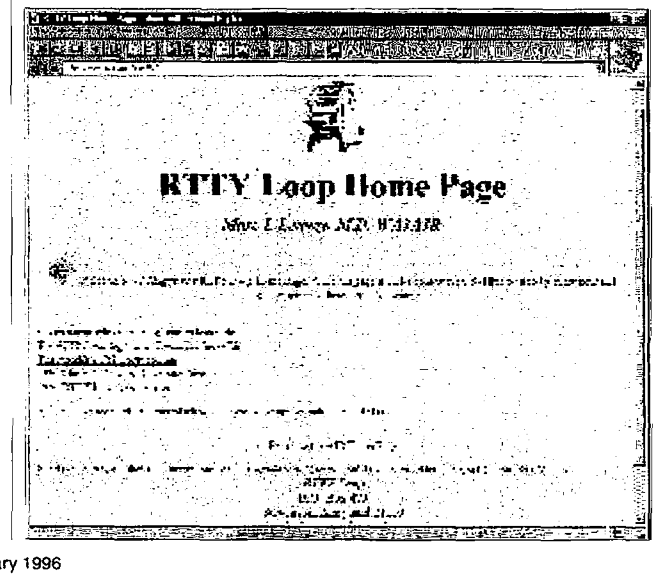
I hope that the RTTY Loop Home Page can be the first home page of an electronic edition of *73*. Let's see what the editors can do with that one!

Along with the new page come new addresses for correspondence. In order to get to your mail in a more timely fashion, I have a new address for the readers of RTTY Loop. Check out the top of the column, and address any snailmail to the P.O. Box. My new Internet address, in conjunction with the home page, is ajr@ari.net — although I continue to maintain accounts on CompuServe and America Online.

I received a note from "RC" KE6BGN, who wrote regarding the sound card article for packet and RTTY. He writes:

"I had a bit of a problem tracking down any of the sound cards that were listed in your article. I was told that of the sound cards you had listed, these were older sound cards and hard to come by. After some hard looking and calling, I found the telephone number of the makers of the Cardinal 16 sound card. They are located in Lancaster, Pa. and their number is: (717) 293-3049. I was told that they are no longer producing this card, but still have some in stock and are letting them go for a mere $60. When I asked them about the software development kit that was mentioned in your article, however, I drew a blank. I will try to find out more on this. This information might be nice to pass on to your readers.

"Also I have a question for you. In the article it said that if you were going to get a sound card to accomplish Packet and RTTY, it had to be based on the PSA standard. During my search, I asked several computer stores what this meant and was only partially answered at one store; that it stood for 'Packet something-or-other.' Needless to say when I heard the word 'packet' from a non-ham, this piqued my curiosity even further. Could you tell me what PSA stands for in relation to sound cards?"



Well, RC, I looked, too, and came up blank. I will assure you that "packet" is anything but an exclusive ham radio term. Most data networks in use today send data in packets, and the protocols in use, one of which is the X.25, often translate into amateur protocols, witness the AX.25 protocol. Good luck on the boards, though, and I will pass along whatever information I discover.

Jack, AAØJB, writes a note via America Online, in which he relates:

"I was reading your article in May 1995 about the program XPKM157 as written by KF7XP for the KAM and I got a copy via AOL and tried it out. Looks good but got a problem. I use COM 3 and IRQ 2 for my TNC. Tried to get the program to initialize but every time I hit the IRQ box my computer locked but good. Had to use the RESET control to get it going again. Would really like to try this program but looks like something is missing.

"Would like to know it KF7XP has a E-mail address. Maybe he knows of the problem and can offer a fix. Also, maybe you know of another place to get the latest download? The one in AOL was several months old. I tried the Internet address in your article but did not find a copy."

Well, Jack, as long as you are using "standard" settings for your COM port, you shouldn't have any problems. The latest copies of the programs can be had on the Internet Direct server, reachable through their web site, http://www.indirect.com, or download the files directly on the ftp site:

ftp://ftp.indirect.com/pub/software/hamradio/xpware. Take a look there, and see if that doesn't help answer your questions.

The Baycom project brought quite a few letters regarding availability of the integrated circuit central to the project. Rev. Greg Schluter, KC5FLI, writes that he obtained the TCM3105 integrated circuit from JDR Microdevices for $8.95. Their toll-free number is (800) 538-5000.

John Kirk, VE6XT, also notes that the chip should be available by mail order from Active Component Sales, as their Canadian parent stocks them. The US 800 number doesn't work in Canada, so he can't verify, but a call to (800) 934-5206 may turn one up. They also claim to stock the rather oddball crystal needed for a very reasonable price.

One last letter this month from Robert Twiggs, WA3YRI, who writes looking for any program for an IBM compatible that will perform RTTY/AMTOR using an AEA-CP1. He currently uses a C64 with AIRDISK and would like to get the thing working with his 486-DX66 PC. He does not have the RS232 option and knows that he will have to use a MAX232 or equivalent circuit to connect to the PC.

Well, Bob, this gives me an excellent opportunity to refer you to the RTTY Loop Software Collection. Several of the packages there may be of help to you, as well as some commercial programs we have mentioned in the column before, such as BMK-MULTY. The easiest way to get a copy of the software list is from the RTTY Loop Home Page but, if you have no web access, drop me a self-addressed, stamped envelope, to the above P.O. Box, please, or send me E-mail at ajr@ari.net on the Internet, or on CompuServe at 75036.2501; or America Online at MarcWA3AJR, and I will be happy to return the list to you. In the meantime, keep on looping, and don't miss the next issue of *73's* "RTTY Loop!"

Number 53 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
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Staten Island NY 10313-0006

Welcome Aboard!

"Welcome Aboard!" is the official Navy greeting. With it, I was invited to be a guest speaker at the U.S. Naval Academy in Annapolis, Maryland. After my wonderful experience last August, addressing the cadets at the West Point amateur radio club, how could I not visit Navy? I accepted the invitation of Lt. Commander Herb Elkins A3FDO and Midshipman 1/C Trevor Bast KA8ZUO, and I was on my way.

The ride over the Chesapeake Bay Bridge is a real experience. The view of the sun going down over the myriad of boats in the water was simply breathtaking. My tour of the "Yard," which is the traditional name of the Naval Academy's campus, was enlightening and impressive. The architecture is a combination of French Renaissance and contemporary style. The campus has expanded to 338 acres. Monuments throughout the Yard commemorate the bravery and heroism that are an important part of the academy's heritage. Buildings and walkways are named for graduates who have contributed to the naval history and to the nation; graduates such as Admirals Chester Nimitz, William "Bull" Halsey and Hyman Rickover, President Jimmy Carter, and 40 astronauts. The brigade-size student body of 4,000 midshipmen participate in a 140-semester-hour program which incorporates a core curriculum of required courses, plus a choice of 18 major fields of study, a wide variety of elective courses, and advanced study and research opportunities for highly motivated students. Classes are taught by 600 highly qualified faculty members. About half are civilian scholars and half are experienced military officers.

My tour guide for most of the day was Trevor Bast, president of the amateur radio club. It was a pleasure to be in the company of such high caliber students as Trevor. One of the highlights of my day was watching the "formation" for lunch outside Bancroft Hall. It's not often that I get to see 4,000 young men and women line up with such precision. It's even less often that I get to eat lunch with such an outstanding group.

W3ADO

While visiting the ham station, I got to meet with Bob Bruninga WB4APR, who is a retired Navy commander and is the trustee and technical coordinator for the station, W3ADO. While the station I visited was in small quarters back in August, the club plans to move to a larger facility. It may have been tight quarters, but the view of the bay was spectacular.

The amateur radio club is the Naval Academy's oldest extracurricular activity, dating back to 1928. For many years it has provided midshipmen with the opportunity to become licensed, to upgrade their present licenses, to enjoy a relaxing hobby, or to pursue specific technical interests within the hobby. The club station is available to all members at any time. In recent years midshipmen have attempted to communicate via moonbounce, satellite, and packet.

Photo A. *Watching a formation of the brigade was an exciting experience.*

Photo B. *(Left to right) Trevor Bast KA3FDO, president of ARC W3ADO, and Lt. Commander Herb Elkins KA3FDO in the "Model Room," in front of a take-apart generator.*

The club is well equipped for HF communications. They currently use a Kenwood TS-440S and an ICOM IC-701 through a Cushcraft R-5 vertical and a G5RV antenna. Three mobile VHF FM transceivers, two Kenwood TM-251As, and a Kenwood HT give excellent 2 meter capabilities. Two PCs, an MFJ 407B, and an AEA Packratt allow them to operate VHF and HF packet from the station. The many technical resources of the academic departments are often available for the club's use. In the past that avenue has provided them with the use of a satellite dish and all-mode VHF capabilities.

The ever-popular and traditional Army-Navy football game provides the club with a reason to set up a special events station every year. Last year on Saturday, December 2nd, they operated from the stadium in Philadelphia for the duration of the game. The normal routine is to operate SSB in the general portion of 20 and 40 meters.

Last spring, the club had the privilege of operating during a shuttle mission as part of the SAREX program. Club members as well as interested faculty were able to communicate with the astronauts for approximately half an hour. The exchange between the *Atlantis* and the midshipmen included each sending the other a short video presentation. "Yeah, I've got color!" Lt. Col. Cameron said upon receiving the academy's video. "Man, great pictures." The exchange represented the first time that a space shuttle has successfully received video from the ground. Usually it's the astronauts who are sending the pictures.

Later that evening I addressed a group of midshipmen who were considering joining the club and wanted to learn more about ham radio. I can't describe how exciting it was for me to look out at a "sea" of white uniforms in the auditorium. With all the demands put on the midshipmen's time, it was nice to see such a good turnout of students interested in pursuing radio. We spoke about the possibility of my lending assistance to those club members who were considering setting up classes in local schools as part of their community service. Perhaps we can do a follow-up column in "Hams With Class" to let folks know how the project went. The ham radio operators at W3ADO seemed very receptive to the idea of scheduling contacts with younger school children. They are an enthusiastic, bright, and extremely hospitable group of young adults.

Photo C. *The members of the W3ADO ARC were an enthusiastic and hospitable group.*

I thank my hosts for a most enjoyable weekend, and I look forward to some outstanding contacts. 73

Photo D. *QSL card for W3ADO.*

HAMSATS

Amateur Radio Via Satellites

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Satellites on a String

Ham radio balloon projects are not new, but they are fun, educational, and exciting. They are a lot easier and cheaper to design, build, and launch than satellites. Amateur balloon launches have been used to test ideas for future satellites, like the pre-AMSAT OSCAR 7 tests in West Germany in the early 1970s.

Most of today's amateur radio balloon launches focus on digital and voice communication experiments and amateur television systems. The payloads usually weigh from 4 to 12 pounds and can be sent to altitudes over 90,000 feet with a $40 balloon and another $50 for helium.

"Today's typical balloon can cost $80,000 and have a payload weight of more than 3,000 pounds."

Payloads are designed for light weight and low current consumption. They must also be built to survive near-vacuum and extreme cold. Power is usually provided by sulphur-dioxide lithium batteries, and antennas are typically omnidirectional ground planes or vertical dipoles. Lots of foil is used for shielding, and styrofoam for padding and rigidity. Voltages, currents, and temperature probes are monitored by small dedicated computers that send data to the ground as telemetry.

After a typical ham radio balloon is launched, the communications experiments, either crossband repeaters or packet digipeaters, find many takers. With an altitude of 100,000 feet, the horizon (as seen from the balloon) is 400 miles distant. For a north Texas launch, it is possible for hams in Salina, Kansas, to talk with others in Corpus Christi, Texas, through an appropriately programmed dual-band HT at the balloon. Video cameras with small 1- to 10-watt ATV transmitters have provided spectacular views from 20 miles up.

When the balloon finally achieves maximum altitude, it pops. A direction-finding team is customarily in place to chase the package as it parachutes back to earth. Years ago this was a grueling "foxhunt," since no one knew where the package would land. Computer predictions help, but the final few miles to the crash site are never easy. Today, many groups use Global Positioning System (GPS) receivers on the package, hooked through packet Terminal Node Controllers (TNCs), and VHF or UHF transmitters to broadcast the location of the payload during the flight. It's much easier to simply note coordinates on a map or laptop computer system, and then walk right up to the payload after landing.

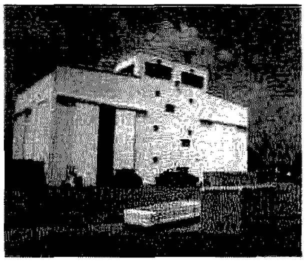

Photo B. One of several buildings at the Palestine, Texas, NSBF facility (Ken Axelson photo).

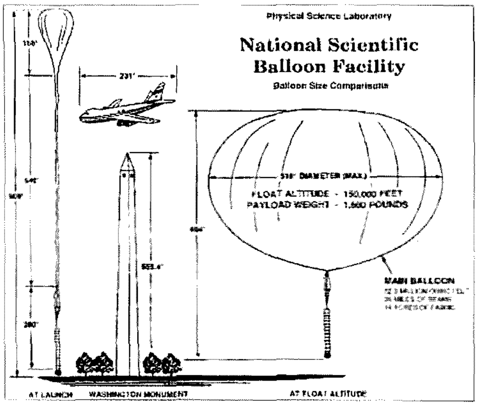

Photo A. Balloon size comparisons (NSBF/NASA drawing).

Three ham radio balloon groups in Texas decided to find out how the "big boys" launch scientific balloons. Members of the South Texas Balloon Launch Team, the North Texas Balloon Project, and the Clear Lake Amateur Radio Club balloon group converged on Palestine, Texas, home of the National Scientific Balloon Facility. These three groups have collectively launched nearly 20 balloon payloads to the edge of space in the last five years.

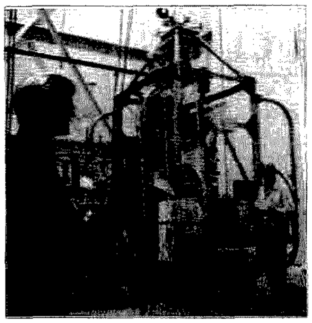

Photo C. Several "serious" payloads are launched from the Palestine location every year. This one was sponsored by educational institutions in California and Italy (Ken Axelson photo).

Go to Buffalo and Head East

Palestine, Texas, is about 180 miles north of Houston and 100 miles south of Dallas, just 36 miles east of Buffalo. This town of 18,000 has been home for the National Scientific Balloon Facility since 1963, when the name was just the Scientific Balloon Facility. Originally aligned with the National Center for Atmospheric Research and the National Science Foundation, the installation is now sponsored by the National Aeronautics and Space Administration (NASA), and operated by the Physical Science Laboratory under the auspices of New Mexico State University of Las Cruces, New Mexico.

The primary goal of the NSBF is to plan and develop facilities and to provide operations to meet the ballooning requirements of the scientific community. The organization also performs research and development to meet future ballooning requirements and provides consulting services in the field of scientific ballooning. It takes a team of 78 engineers and technicians to contribute consulting, helium storage, preflight rigging, launching, tracking, electronic and meteorological support, and payload recovery.

The facility has launched more than 1,700 balloons for 35 universities, 23 other research agencies, and 33 foreign groups. Today the average payload weight is more than 3,000 pounds, with a balloon volume in excess of 28 million cubic feet. Payloads up to 5,000 pounds with 40 million cubic feet of balloon volume are quite common. Top altitudes are usually up to 125,000 feet. A typical balloon may cost $80,000, with $40,000 of helium. It may sound expensive, but it's much cheaper than a typical ...satellite launch.

Payloads cover many types of research, including cosmic-ray studies; gamma-ray, X-ray, optical, infrared, and ultraviolet astronomy; atmospheric sciences; magnetospherics; and micrometeorite particle studies.

Communications gear on the balloon payloads varies from simple to highly sophisticated. For local flights, typical VHF or L-band systems are used for telemetry and control. Long-duration flights, where the payload will travel beyond the horizon, require more complexity. Satellite links through ARGOS, INMARSAT, and NASA's TDRSS are used. The NSBF is involved in multi-day launches from Antarctica which necessitate the satellite links.

The Tour

Dwight Bawcom, manager of the National Scientific Balloon Facility, and Bob Moody K7IRK provided the ham radio balloon groups with a three-hour tour. Dwight began the program with a short talk on the work done at the facility and some videotape footage of various launches from Texas, New Mexico, and Antarctica. It was a great way to get started, since most of those attending were not aware of the tremendous scope of large scientific balloon launches.

Payloads and balloon volumes have increased by a factor

Continued on page 74

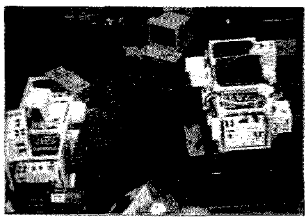

Photo D. A payload test and integration area at the NSBF.

Number 55 on your Feedback card

Low Power Operation

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As I was walking through the hamfest, I spied a Ten-Tec Century 21 lurking deep inside a rusted-out Escort. Upon first impression, it didn't look too bad. There were the usual scratches on the top, and an odd-looking switch where the "spot" function should be.

Looking the rig over, I half-heartedly said, "What are you asking for the 21?" "Two hundred," was the reply. I returned with the usual hamfest barter: "Well, that's a bit more than I wanted to go."

"Well then, what are you willing to go?"

Thinking I would offer a really silly low price and then meet in the middle, I tossed out, "A hundred bucks." He paused for a few seconds, and I knew he was going to counter my offer with something a little higher. He looked up and said, "Sold!"

Ever since I was dropped on my head as a child, I've been hearing voices. But at this moment, one really loud voice could be heard saying, "Captain, the deflectors just came online!" Of course, being my own captain, I set my own course. Ignoring the warning, I asked, "What's wrong with the rig?"

"Nothing. Works great! Just had it on the air last weekend." This time another voice cried, "Engines are standing by! Let's get out of here!" I ignored this warning as well and plunked my money down.

We returned home, and after we'd unpacked and rested a bit, I proceeded to check out my new toy.

Photo A. The power supply shunt inside the Century 21.

The Century 21

For those who can't remember the Century 21, let me take a few minutes to explain this radio. The Century 21 is a five-band CW-only transceiver. It has an RF power output of about 35-40 watts. Of course, this is quite a bit above the 5 watts normally associated with QRP operation. The Century 21 is powered by an internal power supply, with no means of external 12 VDC operation. You can get around this handicap if necessary, though.

It's surprising that the Century 21 is a multiband *direct conversion* based transceiver and not a superhet design. It is also unusual that the Century 21, with its direct conversion receiver, operates with a built-in AC supply. Direct conversion receivers are noted for their pickup of any nearby AC fields and for the hum they generate.

First Problems

Upon powering up the rig, it became instantly clear things were not exactly up to factory specs. First, the 20 meter band was completely dead. Nothing at all could be heard on this band. The other bands seemed to be working—until I tried to transmit. On 80 meters I had all of 15 watts of output, somewhat less on 40. Twenty meters was dead on transmit, too. Ten meters showed little life, but did move the wattmeter's needle up a bit.

Now, to add salt to the wound, those two voices I had heard at the time I was thinking of getting this rig were jumping up and down yelling, "We told you so! We told you so!"

During testing of the transmitter, the overcurrent protection circuit in the power supply kept shutting down the supply. The meter monitoring RF output never reached the point to cause the supply to shut down. After a few minutes of operation, the supply would hardly run the receiver at full volume. So, problem number one was going to be centered on the power supply and its controls.

To prevent the supply from kicking out, I disabled the main +12 volts to the PA stage (something I would get really good at doing).

The power supply inside the Century 21 is built around a design used by several of the Ten-Tec power supplies. In fact, it's basically the same design used in the power supply I had for my old Triton 4.

The design is a basic full wave bridge rectifier and filter capacitor, with a 723 voltage regulator chip doing all the work. A single pass transistor is mounted on the rear apron of the Century 21. What makes the circuit stand out is the overcurrent shutdown protection.

There is a shunt inserted into the negative lead of the power supply. Since the shunt is really a very low value resistor, a small voltage is generated across it. This voltage is applied to a divider circuit and then sent along to an SCR.

As long as the current flowing through the shunt is within the setting provided by RF, the supply operates normally. However, if a problem occurs, such as excess current to the PA stage, then the SCR will fire, removing drive from the pass transistors and shutting down the power supply. To reset the SCR and the power supply, you must turn off the rig, then power back up. If you did not fix the problem, the supply will again shut down. The process will repeat until the current falls to within the setting of the trip trimmer.

One of the best things about the Century 21 is the wide open spaces between the top and bottom covers. You can really walk right in and have plenty of room to work. Upon closer examination of this unit I could see that I was not the first person to touch soldering iron to power supply! There was clearly some damage on the PC board, and several wires had the insulation melted off. There were too many tacked solder joints to count.

A few checks showed that the bulk of the power supply was in working order. This included the transformer and rectifier/filter. The output pass transistor, as well as the driver transistor, had been replaced by someone else. Ten-Tec does not use NTE solid-state devices and three pounds of thermal grease on its pass transistors. The problem was traced to several failed tacked solder joints and a lifted PC board trace. As the circuit heated, the solder joints opened and upset the voltage divider, setting off the SCR which, in turn, shut down the supply.

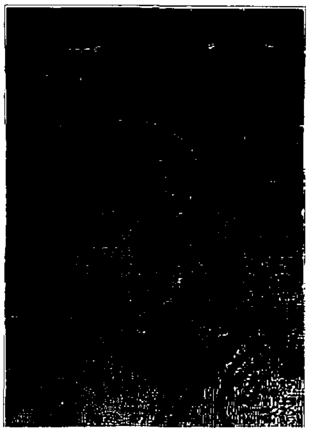

Photo B. Notice the burnt insulation near the terminal strip. The two trimmers on the top of the PC board set the voltage and current trip points for the supply.

Repair consisted of re-soldering all joints and replacing the interconnecting wires between the power supply PC board and the rest of the circuits. The heavy gauge wire to and from the pass transistor was also replaced.

Frying Eggs, Sizzle and Smoke

After putting the power supply back together, I made a quick check; the repairs seemed to be correct. The supply now held on even during receive.

So, with a dummy load and wattmeter attached to the antenna jack, I keyed the unit and attempted to set the RF output with the drive control.

On 80 meters, I had 30+ watts of RF output and 20 watts on 40. I advanced the drive control until it was in its stops and there was still no increase in output power. Then the power supply shut down. Resetting the supply and reducing the drive control again, I attempted to increase drive once more. This time, with the drive control only halfway up, the PA sounded like someone was frying eggs inside. A few seconds later, plumes of smoke started to emerge from the cracks.

After the smoke cleared and the PA cooled down, a look inside revealed that the final transistors, or what remained of them, were history. Now, I wonder if the trouble with the power supply this time (and in the past) was related to the bugs hiding inside the PA?

We'll pick up the pieces and continue next month. 73

Number 56 on your Feedback card

CARR'S CORNER

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Transmission Lines (A Bunch of 'Em)

Fig. 1 shows several basic types of transmission line. Perhaps the oldest and simplest form is the *parallel line* shown in Fig. 1A. This type of transmission line consists of two identical conductors parallel to each other and separated by a dielectric (i.e. insulator). A familiar example of a parallel transmission line is the "twin-lead" used on many television broadcast receiver antennas. For years the microwave application of parallel lines was limited to educational laboratories, where this type of line is well suited to performing experiments (to about 2 GHz) with simple, low-cost instruments. Today, however, printed circuits and hybrid semiconductor packaging have given parallel lines a new lease on life, if not an overwhelming market presence.

The second form of transmission line, which finds considerable application at microwave frequencies, is *coaxial cable* (Figs. 1B through 1E). This form of line consists of two cylindrical conductors sharing the same axis (hence "co-axial") and separated by a dielectric. For low frequencies (in flexible cables), the dielectric may be polyethylene or polyethylene foam, but at higher frequencies Teflon™ and other materials are used. Also used in some applications are dry air and dry nitrogen.

Several forms of coaxial line are available. Flexible coaxial cable is perhaps the most common form. The outer conductor in this type of cable is made of either braid or foil. Again, television broadcast receiver antennas provide an example of such cable. Another form of flexible or semi-flexible coaxial line is *helical line*, in which the outer conductor is spiral wound. *Hardline* is coaxial cable that uses a thin-wall pipe as the outer conductor. Some hardline coax used at microwave frequencies uses a rigid outer conductor, and a solid dielectric.

Gas-filled line is a special case of hardline which is hollow (Fig. 1C), with the center conductor supported by a series of thin ceramic or Teflon™ insulators. The dielectric is either anhydrous (i.e. dry) nitrogen or some other inert gas.

Some flexible microwave coaxial cable uses a solid "air-articulated" dielectric (Fig. 1D), in which the inner insulator is rigid, rather than continuous around the center conductor. Reduced dielectric loss increases the usefulness of the cable at higher frequencies. Double-shielded coaxial cable (Fig. 1E) provides an extra measure of protection against radiation from the line, and EMI from outside sources, from getting into the system.

A variant that seems to combine the advantages of both parallel and coaxial concepts is shown in Fig. 1F. This form of transmission line is called *shielded parallel line*. As in the parallel line, the two conductors are spaced a certain distance (S) apart and are parallel to each other. In the shielded variety, however, an outer conductor (a shield) is also provided.

Stripline, also called *microstripline* (Fig. 1G), is a form of transmission line used at high UHF and microwave frequencies. The stripline consists of a critically-sized conductor over a ground plane conductor, and separated from it by a dielectric. Some striplines are sandwiched between two ground planes, and are separated from each by a dielectric.

The characteristic impedance for a specific type of line is a function of the conductor size, the conductor spacing, the conductor geometry (see Fig. 1 again) and the dielectric constant of the insulating material used between the conductors. The dielectric constant (n) is equal to the reciprocal of the velocity (squared) of the wave when a specific medium is used:

$$\epsilon = \frac{1}{V^2}$$

Where:

n is the dielectric constant

v is the velocity of the wave in the medium

(Note: for a perfect vacuum, n = 1.000).

a) Parallel Line:

$$Z_o = \frac{276}{\sqrt{\epsilon}} \ \mathrm{LOG} \ \frac{2s}{d}$$

Where:

Zo is the characteristic impedance, in ohms

n is the dielectric constant

S is the center-to-center spacing of the conductors

d is the diameter of the conductors

b) Coaxial Line:

$$Z_o = \frac{138}{\sqrt{\epsilon}} \ \mathrm{LOG} \ \frac{D}{d}$$

Where:

D is the diameter of the outer conductor

d is the diameter of the inner conductor

c) Shielded Parallel Line:

$$Z_o = \frac{276}{\sqrt{\epsilon}} \ \mathrm{LOG} \left(2A \times \frac{1-B^2}{1+B^2}\right)$$

Where:

A = s/d

B = s/D

d) Stripline:

$$Z_o = \frac{377}{\sqrt{\epsilon}} \ \frac{T}{W}$$

Where:

nt is the relative dielectric constant of the printed wiring board (PWB)

T is the thickness of the printed wiring board

W is the width of the stripline conductor

The relative dielectric constant (nt) used above differs from the normal dielectric constant of the material used in the PWB. The relative and normal dielectric constants move closer together for larger values of the ratio W/T.

In practical situations we usually don't need to calculate the characteristic impedance of a stripline, but rather design the line to fit a specific system impedance (e.g. 50 ohms). We can make some selection choices of printed circuit material (hence dielectric constant) and thickness, but even these are usually limited in practice by the availability of standardized boards. Thus, stripline *width* is the variable parameter.

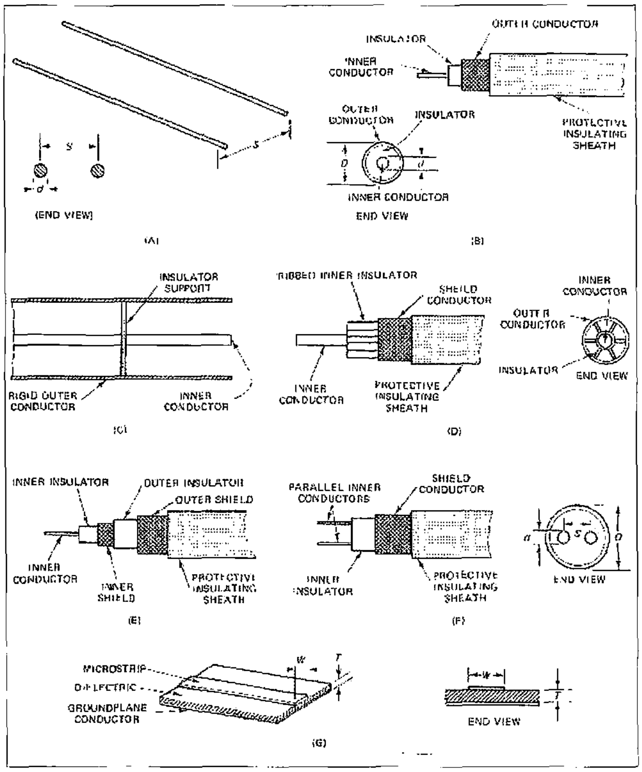

Fig. 1. Types of transmission line.

Equation 5 can be rearranged to the form:

$$W = \frac{377T}{Z_o \cdot \epsilon}$$

The 50-ohm impedance is accepted as standard for RF systems, except in the cable TV industry. The reason is that power handling ability and low-loss operation don't occur at the same characteristic impedance. For coaxial cables, for example, the maximum power handling ability occurs at 30 ohms, while the lowest loss occurs at 77 ohms; 50 ohms is therefore a reasonable trade-off between the two points. In the cable TV industry, however, the RF power levels are minuscule, but lines are long. The trade-off for TV is to use 75 ohms as the standard system impedance in order to take advantage of the reduced attenuation factor.

Velocity Factor

In the discussion preceding this section we discovered that the velocity of the wave or signal in the transmission line is less than the free-space velocity, i.e. less than the speed of light. The velocity is related to the dielectric constant of the insulating material that separates the conductors in the transmission line. Velocity factor (v) is usually specified as a decimal fraction of c, the speed of light (3×10^8 m/s). For example, if the velocity factor of a transmission line is rated at "0.66," then the velocity of the wave is 0.66c, or $(0.66)(3 \times 10^8 \text{ m/s}) = 1.98 \times 10^8$ m/s.

Velocity factor becomes important when designing things like transmission line transformers, or any other device in which the length of the line is important. In most cases, the transmission line length is specified in terms of *electrical length,* which can be either an angular measurement (e.g. 180 degrees or 9 radians), or a relative measure keyed to wavelength (e.g. one-half wavelength, which is the same as 180-degrees). The *physical length* of the line is longer than the equivalent electrical length. For example, let's consider a 1-GHz half-wavelength transmission line.

A rule of thumb tells us that the length of a wave (in meters) in free space is 0.30/F, where frequency (F) is expressed in gigahertz; therefore, a half-wavelength line is 0.15/F. At 1 GHz, the line must be 0.15 meters/1 GHz, or 0.15 meters. If the velocity factor is 0.80, then the *physical length* of the transmission line that will achieve the desired *electrical length* is [(0.15 meters)(v)]/F = [(0.15 meters)(0.80)]/1 GHz = 0.12 meters. The derivation of the "rule of thumb" is left as an exercise for the student. (Hint: It comes from the relationship between wavelength, frequency and velocity of propagation for any form of wave.)

There are certain practical considerations regarding the velocity factor that result from the fact that the physical and electrical lengths are not equal. For example, in a certain type of phased array antenna design radiating elements are spaced a half-wavelength apart, and must be fed 180-degrees (half-wave) out of phase with each other. The simplest interconnect is to use a half-wave transmission line between the 0-degree element and the 180-degree element. According to the standard wisdom, the transmission line will create the 180-degree phase delay required for the correct operation of the antenna. Unfortunately, because of the velocity factor the physical length for a one-half electrical wavelength cable is shorter than the free-space half-wave distance between elements. In other words, the cable will be too short to reach between radiating elements by the amount of the velocity factor!

Clearly, velocity factor is a topic that must be understood before transmission lines can be used in practical situations. Table 1 shows the velocity factors for several types of popular transmission line.

Transmission Line Noise

Transmission lines are capable of generating noise and spurious voltages that are seen by the system as valid signals. Several such sources exist. One source is coupling between noise currents flowing in the outer conductor and the inner conductor. Such currents are induced by nearby electromagnetic interference and other sources (e.g. connection to a noisy ground plane). Although coaxial design reduces noise pickup, compared to parallel line, the potential for EMI exists. Selecting high-grade line, with a high degree of shielding, reduces the problem.

Another source of noise is thermal noises in the resistances and conductances. This type of noise is proportional to resistance and temperature.

There is also noise created by mechanical movement of the cable. One species results from movement of the dielectric against the two conductors. This form of noise is caused by electrostatic discharges in much the same manner as the spark created by rubbing a piece of plastic against woolen cloth.

A second species of mechanically-generated noise is piezoelectricity in the dielectric. Although more common in cheap cables, you should be aware of it. Mechanical deformation of the dielectric causes electrical potentials to be generated.

Both species of mechanically-generated noise can be reduced or eliminated by proper mounting of the cable. Although rarely a problem at lower frequencies, such noise can be significant at microwave frequencies when signals are low. 73

Type of Line	Z_o (ohms)	Vel. Factor (v)
1/2-in. TV Parallel	300	0.95 Line (Air Dielectric)
1-in. TV Parallel	450	0.95 Line (Air Dielectric)
TV Twin-Lead	300	0.82
UHF TV Twin-Lead	300	0.80
Polyethylene Coaxial	*	0.66 Cable
Polyethylene Foam	*	0.79 Coaxial Cable
Air-Space Polyethylene	*	0.86 Foam Coaxial Cable
Teflon™	*	0.70

* Various impedances depending upon cable type.

Table 1. Transmission Line Characteristics

Every Ham's Average

Continued from page 44

value on FM. FSK or other modes where output power is essentially constant.

This article refers to "Average/Peak" reading, because this terminology is normally the accepted wording, although it is not strictly true. The average power of a sine wave is about 63% of peak power, while root-mean-square (rms) of a sine wave is 70.7% of peak value. The rms value of a sine wave delivering power to a non-reflective load is the exact equivalent of a DC voltage of the same value as the rms value when delivering power to a resistive load. This instrument actually indicates rms power levels, which are somewhat higher than average power would be, and therefore are more accurate in indicating the *really effective power* being transmitted. Although I wanted to call the article "RMS/Peak" power, I felt the apparently unusual use of the term "rms" might be confusing, so I bowed to convention and am describing here what is actually happening in this instrument.

Although this RF wattmeter is intended to be left in the coax line between the transmitter and its load, whether dummy, antenna or antenna tuner, you may notice that the output power indicated when using a tuner may differ somewhat from that observed into a 50-ohm dummy load, even though the SWR indicates a 1:1 ratio. There are a couple of reasons for this. First, not all dummy loads are exactly 50 ohms—mine is 51.6 ohms. Second, the output impedance of a transmitter varies with the output level and the operating voltage supplied to the power transistors in the final amplifier stage. The actual output

Continued on page 62

HAM TO HAM

Your Input Welcome Here

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Your Input

I'll begin this month by saying a hearty "thanks" to all who have been sending in their suggestions, modifications, tips, techniques, and favorite easy-to-build circuits. The amount and the quality of input has been very gratifying and if it keeps up as it has been, the column will indeed go on for a very long time to come. This tells Uncle Wayne that it's a needed addition to *73* and encourages me to put even more of your ideas to work via these pages. So keep those ideas coming in; we can never have too many.

Let me just take a moment to outline once again what I'm looking for in the way of ideas. Basically, anything that will help your fellow hams; tips, suggestions or shortcuts are fair game. Things that you've discovered that perhaps you wish you had known about earlier in your own ham radio career are always helpful. The idea can be technical in nature, an operational shortcut or convenience, a new use for a tool that has ham radio applications, or an innovative way of doing something that might otherwise be a real chore. Equipment modifications are sometimes worthwhile, but please make sure that you've thoroughly tested the mod, that it's not going to cause any unwanted side effects, and that it's easily reproducible by others with the same piece of gear—not just a fluke. It's impossible for me to test each idea, especially if it involves an item of equipment that I don't own, so be completely sure that there are no "gotchas" hidden away.

Also, I'm not looking for extremely complex circuits or new and involved concepts; they're best left for full-length articles, or perhaps a doctoral thesis. I'd prefer ideas that can be understood and implemented fairly quickly by all of our readers, ideas encompassing just two or three paragraphs of column space. That allows for more ideas to be published per month, since there are obviously limitations on space within each issue. I'd like to see "Ham To Ham" eventually be the first column read by *73* subscribers...after Uncle Wayne's editorial, of course! The greatest compliment to the contributors will be when a number of readers begin to make a file of the tips and suggestions published here, saving them for future reference. That's pretty much our current goal; let me know whether or not that corresponds with the direction that you'd like to see the column take.

Please don't send me ideas that have been submitted elsewhere and are still pending acceptance by other publications, or ones that have been previously published. Only new, original, unpublished ideas are usable.

I'll try my best to respond as quickly as possible to each legitimate idea sent to me, since I'm sure that you'll want to know if it's what we're looking for. So far, the vast majority of submissions have been right on the mark of what we're intending for the column. This is your column, echoing your ideas and technical suggestions, to make our hobby more fun for each of us.

Photo A. Paul KBØSJX with his HF vertical in the "resting" position, hung from the wooden fence alongside his house...and out of his neighbors' sight.

Putting "Sparkle" Back Into Your Ham Gear

Probably nothing looks less impressive to "visiting dignitaries" than dusty, dingy-looking equipment in your ham shack. You can put that new-look sparkle back into almost any piece of gear by simply applying a small amount of Armor All Protectant® to the equipment's exterior surfaces with a small cotton ball. It comes in both glossy-finish and dull-finish; it's quick and the results are impressive.

"Power-Up" Message Idea

From Bruce Tennant KE6PZW, Box 7325, Long Beach CA 90807-0325: Since some of the newer handie-talkies offer a programmable, customized message upon power-up, here's a tip that might save some grief for your repeater group, as well as enable a stolen HT to be returned to its rightful owner.

The manufacturers of these HTs suggest in their manuals that the owner's name and callsign be programmed into this "power-up message," but by doing that, you may be playing right into the hands of an illegal user. How? Well, should your HT fall into the wrong hands, especially those of a non-ham, then not only would they have your HT, but immediately upon powering it up, they would have your callsign too! The temptation for such unscrupulous thieves to use not just your HT but your call as well may be just too great.

My tip would be: Don't program in your name or call; use your driver's license number or other form of state identification that could possibly place your HT back into your hands should the police or other agency find it as part of the loot of a captured thief. Law enforcement officials have suggested engraving a driver's license number, along with the state's initials (such as CA for California), into valuables for years now. State and local police have access to the legitimate holders of these numbers and have been able to return stolen goods to many people by this method. Another plus is that an unauthorized user probably wouldn't have the sophistication (or the manual to tell him how) to delete your power-up message from the HT's memory, and it might make him more reluctant to use or sell it.

Note: Excellent suggestion, Bruce. Perhaps the manufacturers should market the feature in this manner, i.e. as an anti-theft "plus." It also makes us all think twice about putting our calls on our portable or mobile equipment in any form. A driver's license number would be a much better thing to use, whether it's in electronic form or otherwise.

A Sticky Subject

In case you haven't tried it, a good all-purpose adhesive is Weldbond®. It's made in Canada and is available in the U.S. in craft and hobby stores. There are many uses for this product in our ham-radio construction and repair "adventures," so you may already be familiar with this adhesive. A nice feature is that the bond remains slightly flexible when cured, which in my experience has better impact resistance than adhesives that become hard and brittle after curing or with age.

Now You See It...Now You Don't!

From Bryon "Paul" Veal KBØSJX, 5855 E. 124th Way, Brighton CO 80601: Living in an area with a homeowner's covenant banning permanent outdoor antenna structures, and wanting to operate 10 meters with my new Tech-plus license, while honing my CW skills on 40 meter CW in preparation for the General exam, I was faced with a not-so-unusual modern dilemma...how to accomplish all of that while keeping a low profile with the homeowners' association sleuths! Here's hoping that my answer may help other hams in similar situations.

I purchased a multiband 1/4-wave vertical that I felt had a good reputation for ease of installation and use. My plan? To mount the antenna temporarily on a permanently-installed pipe that extends out of the ground

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Do You Remember?
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QBE?
The 310B?
Any Hunter rig?
The Drake 1A?
Hammurlund, Hallicrafters, and National?
ICE?
Varitronics?
Sideband Engineers, Gonset, and Central Electronics?
Heathkit, Johnson, and Collins?
The Swan 500?
Twin Vs (not "Twin Peaks")?
The "Outercom"?
The 200V?
When all major companies had QSL cards for their employees?
The Warrior?
The 2B (or was it "not to be")?
The SW3?
The Ocean Hopper?

I could go on for hours. But, all the "old-timers" will get the point, and all the "newcomers" will scratch their heads. However, it is nice to take a nostalgic look and just remember.

The Icom 706
Continued from page 40

processors, synthesizers, and memory, and this equates to current drain. The receiver draws 1.5 amps all the time. I measured the total current drain at various power levels at 160 meters and 6 meters. The results are shown in Table 1.

Power consumption is important to me because I use a Ten-Tec 938 switching power supply for portable operation. The cooling fan is always running. It is not noticeable on receive, but it comes on full power whenever you transmit and is noticeable. However, this is understandable, considering the size of the radio and the fact that you are trying to dissipate 176 watts(!) keydown (20A X 13.8V - 100 watts); a good cooling fan is needed. I got used to the fan quickly, and it is really not a problem when you are talking.

There are so many features to this radio that I can't possibly cover them all, but I do have to mention a couple of other neat ones. One of these is the "band scope." With this you can sweep the band and paint a picture of signals on the display very similar to a spectrum analyzer! This is really great for monitoring quiet bands for signals (like 17 meters). Another neat feature is that you can get a display of the IF filter passband which moves right and left as you tune the IF shift!

No rig is perfect, but the IC-706 sure comes close! Now, maybe the Icom engineers or a hacker can figure out how to permit crossband operation so we can operate through some satellites, such as the 15-to-10 meter RS-12, with it.

I like the IC-706. It has virtually all the features you need for base and mobile! Finally, it is user-friendly and works great. Icom definitely has a winner here! I more than got my money's worth with this beaut!

A Hot, Selective 2m Receiver
Continued from page 38

All of this fits easily on the 4" x 3.5" circuit board, making it easy to build the R-100 into a small housing or existing cabinet.

You may be thinking that the R100 sounds like just the ticket—commercial quality, great specs, and a very reasonable price. But the thought of actually putting a whole receiver together from a kit is a little scary. Is not to worry. In the first place, the R-100 uses an IC for the entire IF/Detector/Squelch section, which keeps the overall parts count low. A second IC is used for the audio amplifier section, and five more transistors make up the total active device count. Second, the instruction manual is quite explicit, the parts are well-marked, and the double-sided plated-through PC board makes the soldering easy. And third, well, if the unthinkable should happen, there is an in-depth troubleshooting section that should lead you to the source of the problem. The R-100 can probably be assembled in a few casual evenings, or in one night if you're an experienced (or highly motivated) builder.

In any case, the R-100 is probably not an ideal first-timer kit, but it would certainly qualify as suitable for an intermediate builder. As usual, the Hamtronics manual doesn't stop simply with construction details. Tips are given on how to mount the receiver, how to connect antennas, how to use the R-100 in a repeater, how to add a discriminator meter and S-meter, and even how to hook up subaudible tone decoders. Once built, you'll need a high-impedance voltmeter and a signal generator for alignment—both pieces of equipment are usually available through some member of your ham club if you don't have them already. (One thing you'll need that you may not have, and Hamtronics doesn't give you, is a set of tuning tools for the square-holed slugs in the coils. You can order one at the same time you order the radio.)

Whether you use the R-100 as a monitor receiver for the local repeater, a dedicated RF link, or as the receiver in a 2m repeater, you'll find it to be rock-solid, even in heavy RF environments. The R-100 is available in kit form, or fully assembled. Crystals are optional, and are available from Hamtronics, Inc.

Ham to Ham

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about three feet and into the ground about five feet. The manufacturer's recommended ground radial system was also installed beneath the sod and securely connected to the same pipe, along with a 14-foot commercial-grade ground rod. The need for a good grounding and radial system for any 1/4-wave vertical antenna installation cannot be over-stressed. The outside diameter of this ground pipe is such that the antenna easily slips right down over it, rests on a ring clamp, tightens with a second clamp, and provides a sturdy support for the remainder of the antenna for the time it will actually be up in the air. Remember, it doesn't stay up at all times, only when I want to operate for a while.

The coax back to the indoor radio room in my home is buried beneath the turf about four to six inches, both for protection against damage and for appearance purposes. Make sure that the coax you use is rated for underground applications and that the outer jacket is free of any nicks that might allow moisture into the shield of the inner cable. A quick-disconnect fitting on the coax itself completes the job, but remember to protect this fitting from direct exposure to the weather when not in use.

Photo B. KBØSJX positioning his antenna so that it may be dropped over a pipe driven into the ground at the rear of his fenced-in property. The coaxial cable from his shack meets up with the antenna and the "instant antenna-raising ceremony" is complete.

My "temporary" antenna mount is in back by my property's rear wooden fence, so when my operating time is over, I can simply disconnect the coax, loosen the bottom clamp, lift off the antenna, and hang it from supports attached to the fence itself. The operation takes only a minute or two. The antenna alone is very light in weight, about the same as a heavy-duty deep sea fishing pole...including the bait! The "stored" length along the fence is 18 feet in my case. The photos give you a much better idea of the arrangement that I'm describing. The entire scheme is virtually invisible to the association sleuths for the 90% of the time that I'm off-the-air.

Note: Paul has a nice arrangement here, with possibilities for others in similar circumstances. Photos A and B tell the story best. A hinge-and-lock arrangement might also be helpful (for us older folk) so that the antenna could be "walked" up and down instead of lifted into place, yet it could still be hidden behind the fence when resting in the horizontal position. Such an arrangement might also be used with some of the popular half-wave verticals using a similar design. Lots of "custom" possibilities here; thanks, Paul. By the way, Paul wrote to tell me that he did receive his General...congratulations!

"Green" Is Good!

Here's another tip about an interesting product that's available at most local hobby shops, called Squadron Green Putty®. It's a very quick-drying filler that can be used around the ham shack to fill unwanted holes in panels or cases, or to make a chip or crack virtually disappear in a plastic front panel escutcheon.

That's all for this month. Please keep the ideas rolling in to the address shown in the masthead. And remember, this is your column, where all of the ideas are from one ham to another, which is always the best way! And it doesn't matter how long you've been in the hobby—Paul KBØSJX has been licensed less than one year, yet he saw a workable solution to an common problem. Let's hear from you next month!

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to "Ham To Ham," c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. I will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to me or *73*.

Every Ham's Average

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impedance of a solid-state transmitter will very seldom be exactly 50 ohms, although at its rated output power it will be very close.

The problem lies in the fact that the collector impedance of the final amplifier in a solid-state transmitter is very low—about 1.9 ohms for a 100-watt output transmitter operating on 13.8 VDC. To provide a nominal 50-ohm output impedance requires a step-up output transformer which can have only a finite number of turns on each winding. In the case of the 100-watt transmitter the step-up transformer has to transform 1.9 ohms to 50 ohms, or close to it. The transformer requires a 1:25 impedance step-up, from 1.9 ohms to 47.5 ohms. The turns ratio, which is the square root of the required impedance ratio, is therefore 1:5. Because there can be no partial turns on a transformer, there is no way to produce an exactly 50-ohm output impedance with a transmitter producing 100 watts and operating at 13.8 VDC on the final collectors. So, while the indicated power output may differ from that observed into exactly 50 ohms resistive, it isn't anything to be concerned about.

An entirely different thing occurs when this 100-watt transmitter has its output power reduced to 5 watts to operate QRP, which hams do occasionally. With the DC voltage remaining at 13.8 volts, the collector impedance has changed to 19 ohms! The same step-up output transformer with a 1:25 step-up ratio now transforms the 19-ohm collector impedance to about 475 ohms! Although most antenna tuners can match the input to the transmitter output for an SWR of 1:1 or close to it, the wattmeter between the transmitter and antenna tuner is now looking at a 475-ohm load instead of the 50 ohms it is designed for. Thus, the power output indication may, therefore, be in error.

In all cases you should adjust your transmitter to the power output desired into a 50-ohm dummy load, especially at QRPp and QRP levels. Then, regardless of the indications on the RF wattmeter when operating into a load other than 50 ohms, the power output will either be the same or slightly less as long as the SWR is 1:1 or close to it. For all practical cases, consider your power output to be the same as that measured into your dummy load. The ham at the distant station you're in QSO with won't care.

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Every Ham's Average

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Parts List

C1 22 µF 10V electrolytic capacitor
C2, C3, C4 0.01 or 0.1 µF ceramic disc
D1, D2, D3, D4 Germanium diode: 1N34A, 1N60, 1N90, 1N270, etc.
J1, J2, J3, J4 RF coax jacks, builder's choice
M1 100 µA DM meter
R1 68k ohms 1/4W ±5%
R2 50k ohm trimpot
R3 7.5k ohm 1/4W ±1%
R4, R6 4.3k ohm 1/4W ±1%
R5 33k ohm 1/4W ±1%
R7 75k ohm 1/2 or 1 watt ±1% (See text)
R8 1.2k ohm 1/4 W ±1%

Calibration	Voltage
15	8.66
14	8.37
13	8.06
12	7.75
11	7.42
10	7.07
9	6.71
8	6.32
7	5.92
6	5.47
5	5.00
4	4.48
3	3.89
2	3.16
1	2.24

Table 1. Calibration Voltages

Above & Beyond

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119

Mounting and Pointing Lasers

This month I thought I would try to make a big red splash and cover HeNe lasers. For most of us the HeNe or helium-neon laser is just a red glow at the supermarket checkout counter. It's the light source for the price scanner. In some units this could be a diode laser or a tube-type laser. Both of these units emit a bright red beam that is characteristic of a helium-neon (HeNe for short) laser.

The HeNe laser is available in surplus mostly in the 5 to 10 mW power range. Most are used in price checkout stands, laser printers or the older very large industrial printers and some copy machines. Recently we salvaged some lasers by removing them from these types of devices. They were 10 mW laser power heads with focusing optics mirrors and Brag cells. These accessories were used to focus and position the laser beam. The Brag cell is a polished crystalline square structure of lithium niobate. It is this crystal structure through which the laser beam is passed. The cell has two electroplated sets of contacts through which RF energy drives the crystal structure. This drive on the cell structure causes the beam to vary or react to the modulated RF imposed on it (100 mW of power at a frequency of 60 to 90 MHz is normally used). The Brag cell was used to modulate the laser beam for use in printers. Lasers are classified as Type I, Type II, or Type III. The 10 mW laser is a Type III high-power laser and should be used with caution. It carries warnings concerning safety and eye protection.

For safety's sake never look into a laser beam.

Why do we want to use a HeNe for amateur purposes? Well, most things obtained from minimal-budget scrounging-and-foraging missions in commercial and industrial junkyards allow us to have fun with ever-varying surplus electronics that can be quite sophisticated and still inexpensive. By taking advantage of good deals in surplus scrap you can save big compared to buying from your local surplus dealer.

In with the surplus lasers obtained in one batch was a Brag cell laser modulator. The laser, together with the Brag cell modulator, was the mechanism that transferred data to the laser and then to a printed page, in accordance with the printing instructions set. I am not sure just what the original material was, but in any case, as amateurs it is not too important that we know just how a laser printer or copier functions but rather how we can adapt these components to our use.

Most items discarded by commercial industry have a defect of some sort making them unusable to the company. These defects can be overlooked if the device can be made to function in some other-than-normal manner that is still safe and functional.

The remaining metal mount for the laser looked quite bad, but with all the optics still intact with the Brag cell, I decided to use it for my basic laser mount as it was sturdy and allowed some adjustment for laser position.

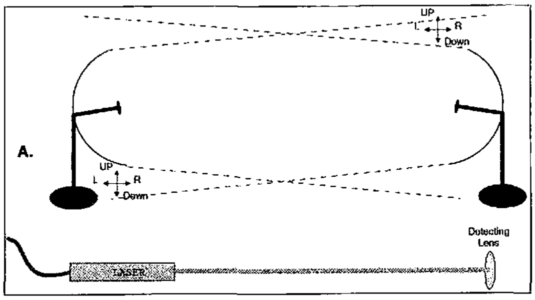

Fig. 1. Comparison between laser and microwave systems and their aiming/directional differences.

This mount had a very fine rack-and-pinion that could be used to adjust the laser mounting in respect to the optics. In addition to the rack-and-pinion there was a two-stage ring mount that held another (smashed) glass laser. Now if you are not into weird science and lasers and optics these parts might not excite you. However, if you intend to do any communication with lasers, the need to point with pinpoint accuracy is quite important and the mechanical considerations just as serious.

Electronics in general is my primary interest, delving into which I have expended a great deal of energy and effort. However, mechanical considerations have always left me in the dust, as my primary tools in the early days were a hand drill and a good set of hole punches, with an assortment of files to do the rest of the dirty work. Remember cutting out a meter hole by drilling the perimeter with about 40 small holes and then breaking it out and filing to fit? Well, these techniques don't work with optics; you don't have that tolerance for error.

En Garde!

Take for instance the pointing of a laser at a particular spot. If it's a blackboard or some similar target in the same room you are, this is a simple task. When the distance increases substantially, say, several miles, the pointing becomes quite acute. It's kind of like fencing with a pinpoint sword several miles long. A very small movement at the wrist produces a gigantic movement at the opposite end of the sword. With a laser the scenario is identical. The ability to point with micro-control accuracy is quite important in the mount.

The aiming operation is just the opposite of a microwave dish antenna where dish diameters are in the 30-inch to larger dimensions. Both lasers and microwaves can use gun sighting optics for sighting-in distant objects that track with the main dish or laser beam. At this point some small micro movement is required to acquire the distant object.

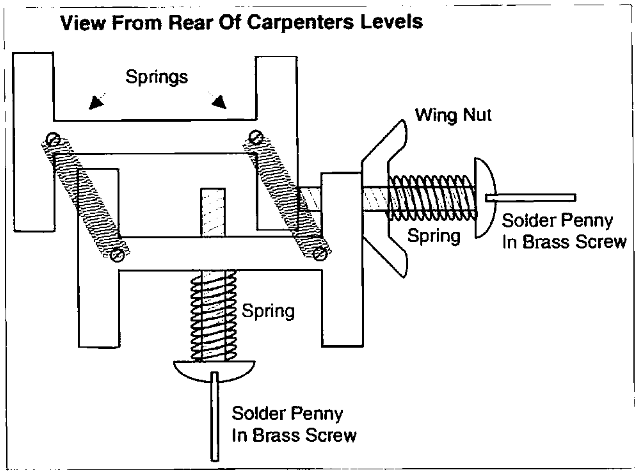

Fig. 2. End section drawing of a laser two-screw positioning mount using two metal carpenter levels.

With lasers it would be to "Drop the spot on the distant detector," and with microwave it would be to "Rock and Lock" one end while the other end reports on the progress of the opposite's moment in signal strength. In the microwave instance, each end of the path can make fine adjustments based on signal strength to each other. By making several of these small angle alignment corrections to the dish orientation at each end of the path several times, you rock the antenna orientation in to each other eventually. See Fig. 1 for aiming concept.

For optical systems, pointing a laser at a target is not quite as simple as in a microwave system. In a laser system, one end must first scan the target to remove errors in point angle, and when the opposite end receives the laser beam of light as detected by its optical receiver, you might be in reverse alignment. That is, the previous receiving station might have good-enough alignment between its receiving optics and transmitting laser to be on (or somewhat close to) transmitting alignment at this time.

In any case, one end must first acquire the other end and then a two-way communications path can be established. Ideally, either end's laser is in alignment with the receiving mechanism, and both are parallel to an exact degree. In the real world some small adjustment is necessary. If the distance is extreme, say, fifty miles versus five miles, then a whole new stance must be taken into account.

At five miles, the typical laser beam diverges or spreads out from a very small spot to one that is about five feet in diameter. This makes it a little easier to point but, still, at even this distance it's not shooting fish in a barrel. There can't be any wobble in the cog here! If you think that hand-pointing a laser will do the trick at paths of a few miles, you need some rethinking. N6IZW and I tried this first-cut "simple" path quite some time ago and found that, with adjustable tripods and with pointer sighting (direct view) to the target, it was not as easy as you would imagine.

The tripod we were using is the same one that is normally used for microwave communications with a large-aperture dish antenna. This microwave conglomeration worked out quite well: signals were so loud that even when the antennas were not pointing correctly we were able to make contact. Pointing the laser using the same tripod showed that a far more accurate pointing mechanism was needed to accurately point a laser at a target. The microwave alignment took about two minutes and the laser pointing took an hour for one-way tests.

The microwave dish pointing arrangements worked well for microwave but were just not capable of the finer resolution needed to aim the laser beam properly at the target. True, we finally succeeded but with lots of effort and meticulous pointing adjustments continuously being made at the laser end of the path. To bring home this point, examine a yardstick lashed securely in the middle (18-inch point) to a good heavy tripod. Now imagine tapping one end ever so lightly with a pencil point and watch the effect on the other end. With a stick or laser beam five or even fifty miles long you're looking at a movement like a freight train passing by. The basic mount has to be very sturdy and some magnitude sturdier than a very good microwave tripod. In a 50-mile laser contact, I would suggest using a metal lathe table as the optical bench stand.

For contacts in the five-mile range, simpler equipment can be employed. The basic microwave tripod can be used for basic pointing. Then the mount attached to the tripod base that houses the laser and rifle spotting scope and receiving photo detector must all be capable of individual fine adjustment. This adjustment scheme is independent of the tripod adjustments. The finer-adjustment mechanism needs to address vertical- and horizontal- position movement. I would suggest looking for something to which a very fine-pitched screw or micrometer can be attached, to handle the final pointing attitude adjustment. See Fig. 2, which covers the two-screw adjustment technique.

In its simplest form a fine-pitched screw can be used with a counter spring in both the vertical and horizontal planes. The counter springs are used to load the screw properly to prevent backlash movement. What type of screw is best? Well, any one with fine threads will work but the finer the better. What I would suggest using would be something that would mimic a commercial micrometer shaft and dial mechanism, or using two inexpensive micrometers themselves may be the best choice. Check out old WWII microwave generators for klystron tubes, as some had micrometers attached to them for tuning. If you decide to purchase them new, hold on to your hat—they cost $50 to $60 each.

I would prefer to try swap meets to locate old worn or used micrometers, even when too worn for industrial use. We want their fine-threaded mechanism for position accuracy, not measurement. In any event, exactly what you use is not important. Just use a device or screw that has a fine-pitch thread, allowing you a fine movement as the screw is turned against its stop.

I have seen two metal levels used for the laser table mount, with one end fixed and the other end with the vertical/horizontal screws and springs for position control. It's simple and quite inexpensive for experimentation, constructed from two wide "H" frame aluminum levels. One level is set on top of the first level, off-set by the "H" frame. See figure 3 for the end view of the two levels. So much for the mount. What types of lasers are available in the surplus market?

The typical Helium Neon (HeNe) laser comes in two styles: a glass tube, and a "head." The basic laser is a glass tube with suitable mirrors on either end and high-voltage clips to attach to the tube for connection to the power supply. When this glass tube is enclosed within a metal container it is called a "head." The glass-tube laser and its high-voltage connections are protected by the metal tube. Usually the high-voltage is tied common to the metal tube as a system ground. Because of voltage in the 1000 or more volts needed to operate lasers, be very cautious and use proper grounding techniques.

There does not appear to be any method of determining what power a laser is by just looking at the device. However a 10-mW unit can be generally regarded as larger in comparison to a 1-mW unit from the same manufacturer. Most of the 10-mW units that I have been able to pick up in surplus are about 16 to 18 inches long and 1-3/4 inch in diameter. They come with a shutter for the laser output end and a shielded cable for power supply connections.

Don't short-circuit yourself: remove the cable connector. It's a special high-voltage connector that is polarized, allowing the proper potentials to be applied to the laser head. Additionally, by being polarized it maintains system ground to the laser head tube.

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Welcome Newcomers

Join the ARRA

Wayne Green W2NSD/1

You've been nominated to be a member of the ARRA. So what's the ARRA, a new national ham group? Yep, one with no officers to sit in high places and look down benevolently on us peons, no directors to pass on the pronouncements from the officers, no dues you can't afford, and not even any bylaws to keep out the unwelcome. It's the Amateur Radio Rescue Association, so try as best you can not to confuse it with the ARRL, a Morse code radio relaying group.

Your sole duties, if you sign up as a member of the ARRA, will be to get on the local repeaters and do your best to convince the no-coders that there really is life below 144 MHz. We've got to somehow convince these guys to go for their General tickets...to rescue them from their lonely outpost on 2m. Get those hermits out of their caves and into our ham society. Just think, they may even be missing those endless self-promoting sermons from K1MAN!

When I saw the FCC figures showing the license figures for the last 10 years (see page 65 last month for the bad news), and I saw that despite the explosion of Techs there had been not even the slightest budge in the growth of the higher class licenses, I knew (a) that my efforts with *Radio Fun* to get Techs to upgrade had totally failed, and (b) that the rest of us have not been making a serious effort to get them to upgrade. We now have well over 350,000 Novices and Techs, over 90% of whom have shown no sign of making any effort to upgrade.

This means a couple of bad news things for the AGE group (Advanced-General-Extra). First, it means that one of these days the FCC may possibly notice that the Tech license has totally failed in its whole excuse for being. And this could easily trigger some rethinking of the amateur service, which is right down there at the bottom of the things we want the FCC to think about. Second, it means that when you normalize those "growth" curves by taking into consideration the almost 50% dropout of licensees when that 10-year renewal time finally arrives (through Silent Key-ism, boredom, other priorities such as the XYL and harmonics, job changes, or an interest in newer and more exciting hobbies), we're actually dwindling in numbers. But anyone who's been hamming for a few years recognizes that the bands are noticeably less populated than they used to be. The pileups are more like small heaps. The DX lists are shorter. And the lack of sales of new equipment has the manufacturers and dealers wringing their hands in panic.

"Get 'em involved with your club and then put on demonstrations of HF packet, slow-scan, RTTY and all the other good stuff we have to keep 'em busy for a few years."

A Call To Action!

Your help is desperately needed to turn this disaster around. Your help is needed to get up on 2m and convince the new permanent residents that there really are some fun things to do on the HF bands. Keep on talking about what you've been doing on the other bands. The interesting nets on 75 (yes, there are some), the DX on 20 and 40. The openings on 15 as the sunspots blossom.

Let's get more of our repeaters to work crossband to the low bands. I used to have WR1AAB, my repeater on Pack Monadnock, so it would crossband to either 6m and 10m. It's no big deal to do, but it sure does give the 2m hermits a little peak into the outside world. Maybe you can organize groups in your club to beat the 2m bushes and get the Techs to come to meetings where you can help them upgrade with tech sessions and maybe even some 13-per code. If you teach 'em 13-per my way, they'll learn it in a fraction of the usual time and avoid entirely that incredibly frustrating 10 wpm plateau.

Get 'em involved with your club and then put on demonstrations of HF packet, slow-scan, RTTY and all the other good stuff we have to keep 'em busy for a few years. If you're properly geared up, contests can be a blast. I had a ball in the Sweepstakes for many years. Ditto DX contests, VHF contests, and so on. Get 'em interested in certificates. Get your DXers to show off their cards. If you have any DXpeditioners around, have them put on a slide or video show of their recent DXpeditions.

But the main thing is to invest some time on 2m and help pry the barnacles loose from the repeaters and get them to upgrade. Treating 'em like CBers will alienate them and they'll soon be everything you dread. No, you've got to get up there and mix in and do your selling job.

If you know anything about selling, you understand that to sell you have to point out the benefits to your customer of the product you're selling. Thus, instead of putting Techs down for being lazy, keep at 'em on the fun they're missing. If you can't set up some crossband contacts to give them a taste, at least play some tapes of DX you've worked. Brow-beating won't work. Shame won't work. Being nasty sure won't work. Those are proven ways not to sell. Pictures of $100,000 shacks on the cover of ham rags isn't much of a turn-on either. Look, if the Techs on 2m act like CBers, it's you who's made it happen, either by not talking them down to the HF bands, or by being unfriendly on 2m.

Sure, there are some real jerks on CB. But if I were just getting interested in radio communications, that's where I'd head to start. And I've had endless wonderful contacts on CB. I find that often I have a better chance at talking with people on CB than I do on 2m when I visit a city. On 2m I'm either frozen out by a closed repeater or ignored when I call in. Hello, is anyone there? Not often.

You personally can do more to help keep amateur radio alive if you join the ARRA and proselytize the HFs to our increasingly alienated Techs. Maybe we should organize some merit badges for successful Generalizations of Techs. I'll be watching the club newsletters for word of 2m rescue activities. Oh yes, one more thing, please call your club secretary and get him or her to put me on their mailing list. I want to keep track of what your club is doing. Or not doing. Wayne Green W2NSD/1 - 73 Magazine - 70 N202 - Peterborough NH 03458-1107. Please don't disappoint me.

And if I see a mention of the ARRA in the club newsletter I'll send one of my free prize subscription offers to the club. Yes, that's a bribe. 73

Communications Simplified, Part 2

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After our introduction to sound and audio in the first part, we now continue with pictures and video.

Video

You can send pictures through communications in various ways, but the most common means today are fax machines and television. So let's talk about those.

Fax Machines

Twenty years ago, fax machines were very rare, though not entirely unknown. Currently, almost every office has at least one fax machine.

Today's fax machine can send letters, pictures, cartoons, photos, and almost anything that you can feed through its slot. Shown in Fig. 1, the typical machine consists of five parts: (1) a scanner that can scan a printed page and convert it into an electrical signal; (2) a printer that can take such an electrical signal and print it on paper; (3) a telephone and dial by which to call other machines;(4) a modem that couples the digital circuitry to the telephone line; and (5) a microprocessor that ties it all together and makes it work.

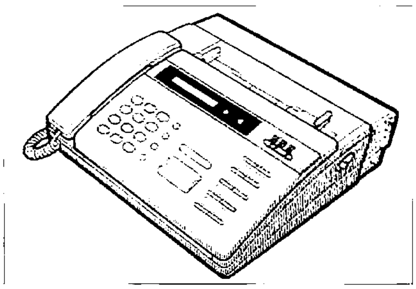

Fig. 1. A typical fax machine.

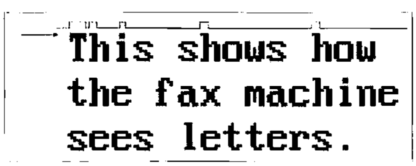

Fig. 2. Enlarged view of some text being sent.

Since the fax machine contains both a scanner and a printer, it can usually be used as a copier; that is, it can scan one piece of paper, and at the same time create a copy of it in the printer. But that's a secondary function. Its main purpose is to transmit that page through the phone to another machine.

To begin the process, you insert the page you want to send into a slot on the fax machine (the slot is on top of the machine illustrated), pick up the handset, dial the number of the machine you want to reach, and wait for the call to go through.

When the called machine answers, it sends back some tones whose purpose is to let your machine know that the connection has been made. When you hear these, you generally press a START button, hang up the handset, and wait for the call to finish.

Let's skip ahead to this point, and look at how your fax machine scans the page you want to send. Fig. 2 shows an enlarged view of some typewritten text that we want to send.

When you push the START button, a photosensitive scanner head starts to sweep across your page, from left to right, starting at the upper left corner. The small arrow at the top left of Fig. 2 shows where the scanner starts and the direction in which it moves. It never sees your entire text; rather only the narrow area of white and black over which it passes. Also, the scanner sees only the tops of the letters "th" and the top of the dot over the "i" (as well as the tops of the two "h"s farther on the right), since all the other letters are shorter. As it scans from left to right, it sees the dark areas shown in Fig. 3.

This is an important concept to understand: The fax machine doesn't actually try to read the letters themselves. It only looks at the patterns of white and black. In other words, your page could contain English, Chinese, or Russian letters, drawings, or chicken scratchings. Only the patterns of light and dark are sent.

As the scanner goes across the page, it outputs a waveform like that shown at the top of Fig. 2. This is a digital signal that shows a low value of voltage when the scanner is passing over white paper, and a higher voltage when it passes over black ink. Although more expensive fax machines can handle grays, the typical cheap fax machine doesn't sense differences in grays. If a gray is light, it's treated as if it is white; and if it's dark, then it's assumed to be black.

As the scanner head is moving right, its output is sent to the microprocessor as a digital signal. When the head reaches the right margin, the microprocessor goes to work; meanwhile, the head returns back to the left and the paper moves up about 0.005 inch. Eventually (after the microprocessor has finished processing this signal), the head will start another sweep across the page, but this time about 0.005 inch lower down on the paper. It will then scan another strip of text, and so on, until it eventually reaches the bottom of the page. In this way, the 11-inch height of the paper is divided into about 2200 strips, each about 1/200 of an inch high (that's equal to 0.005 inch), and each strip is scanned for light and dark areas across the width of the paper.

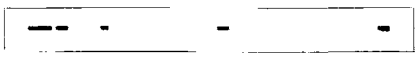

Fig. 3. What the fax scanner sees.

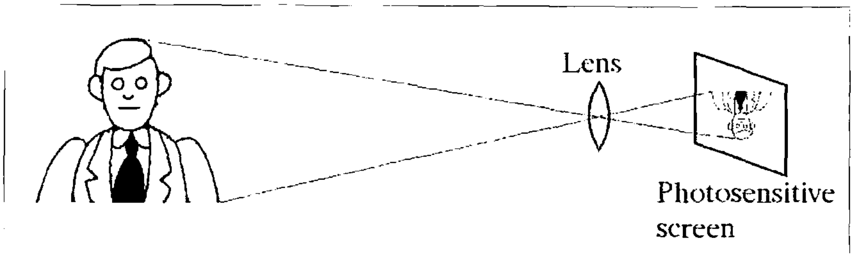

Fig. 4. A simplified black-and-white TV camera.

But let's return to the microprocessor, which gets the signal shown at the top of Fig. 2. This signal has only two voltage levels (assuming we're dealing with an inexpensive black-and-white fax machine.) A digital signal like this can't be directly sent through the telephone line; besides, it would be inefficient to do so. And so the microprocessor analyzes the signal and sends a *description* of the signal, rather than the signal itself.

The microprocessor measures distance on the paper in *pixels* rather than inches; each pixel being 0.005 inch. (A typical fax machine actually has a fine mode and a coarse mode, depending on the sharpness and detail you want. I am using the numbers for fine mode in this description.) The word pixel is an abbreviation for *picture element*, and it is the smallest spot that the fax machine can see or print. If you look at the printout in Fig. 2, you can see that the letters look as though they are made out of square blocks; these are the pixels. The 8.5-inch width of the paper is therefore about 1700 pixels wide.

As the microprocessor receives the signal from the scanner head, it counts off the number of pixels of white and black, and generates a description of the signal in terms of pixels. For example, if it sees an entirely blank sheet of paper, it simply sends a message to the other machine that there are 1700 white pixels. On the other hand, if there is a lot of printing on that line, the description might read:

- 10 white pixels
- 3 black pixels
- 17 white pixels
- 7 black pixels
- 12 white pixels
- 9 black pixels, etc.

You can see that the description of a blank line is a lot shorter than the description of a line with a lot of print. Hence, how long it takes to send a page depends on how much writing is on it. A blank page might feed through in 10 or 15 seconds, an average letter might take 30 seconds, or a page of newsprint might take almost 2 minutes. You can notice the difference as you watch the machine send or receive a page. Blank or nearly blank pages feed through at a speedy clip; complex pages feed through in tiny spurts.

The advantage of sending descriptions rather than the actual waveform is that *for an average page* this takes less time than would sending the actual waveform.

At this point, it doesn't pay to delve much deeper into the fax machine, since my primary purpose in discussing fax machines is to lead into a discussion of TV; let's just say that the description coming out of the microprocessor is itself a digital message. Since the telephone line is not able to carry digital data directly, a *modem* converts the digital data into tones that are then transmitted through the line. The word modem stands for *mo*dulator/*dem*odulator, the device that converts (modulates) data to tones on one end, and then changes (demodulates) the tones back to digital data at the other end.

Before moving on to TV, let's just summarize: The fax machine divides the printed page into horizontal strips about 0.005 inch high (and therefore about 2200 strips per 11-inch page), and scans each strip from left to right. The black/white information from each strip is sent from the sending machine to the receiving machine, but as a description rather than as the data itself. It takes anywhere from 10 seconds to perhaps 2 minutes to send a page, depending on its complexity, which means that the time to send the information for one strip takes anywhere from 10/2200 second (about 0.005 second) for a near-blank page, up to about 120/2200 second (about 0.06 second) for a fairly complicated page. In terms of what we learned about bandwidth in Part 1, it takes a fairly long time to send the picture an therefore not much bandwidth is needed.

Television

Let's summarize normal TV in terms similar to what we just did for fax machines. The TV camera divides a picture into 525 nearly-horizontal strips (the height of the strip depends on the sizeof your TV screen), and scans each from left to right. The information, which includes not just black and white but also grays and colors, is sent as the actual waveform, not as a description. Regardless of how complex, light, or dark the picture is, it takes the same 1/30 of a second to send that waveform. Furthermore, in order to provide the feeling of motion, the TV camera sends 30 complete pictures per second. As you can guess, the bandwidth for a TV signal must be much higher than that of the fax signal.

Let's look first at what the TV camera does. Fig. 4 shows how a lens focuses an image of a person onto a photosensitive plate inside the camera. In studio cameras, that photosensitive plate is inside a vacuum tube called an *iconoscope*. Older home cameras used *vidicons*, whereas the latest home cameras use charge-coupled devices (CCDs). Either way, the photosensitive screen gets an upside-down image of whatever the camera is pointed at. This image is then split into strips and scanned.

In an iconoscope or vidicon, that scanning is done by a thin electron beam, which is aimed at the screen; in the CCD, the screen is itself divided into tiny spots, each of which can measure the amount of light hitting it, and electronic circuitry then interrogates each spot to see how much light it got. Since the studio cameras use iconoscopes, I will talk about the beam as doing the scanning.

As in the fax machine, scanning is done from left to right, and top to bottom of the picture. But since the picture in the TV camera is upside down, in the camera it starts at the bottom right, and goes from right to left, and bottom to top, as shown in Fig. 5.

You'll note that, unlike in the fax machine, the strips in the TV camera are not exactly horizontal. There is a very slight tilt to them, because as the scanning goes

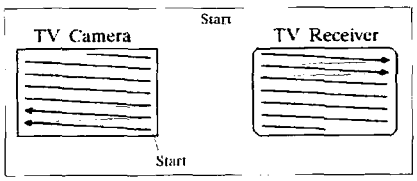

Fig. 5. Scanning in the camera and receiver.

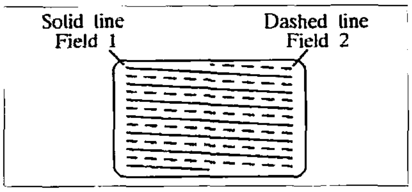

Fig. 6. Two fields make a frame.

from side to side, it is also moving upward, although much more slowly. You can also see a thin line, called a *retrace* line, which shows how the beam jumps from the end of one line to the beginning of the next.

Fig. 5 also shows the beam as it moves in the picture tube in your home TV receiver. Here again, you will note that there is a slight tilt to the lines,. but here the scanning starts at the top left, and so the beam moves slightly down as it moves right. What is impressive about the whole setup is that the beam in the camera is exactly synchronized with the beam in not just your TV set, but also the beam in every single other set that is tuned to the same station. At the exact instant that the beam is at the bottom right corner of the camera screen, it is at the top left corner of possibly millions of TV sets around the country. This must be so to make sure that an item in any particular spot of the picture shows up in the corresponding spot on the screen!

Let's return to Fig. 5. The correct name for what we have been calling strips is actually *scan lines* or *sweep lines*. We mentioned earlier that there are 525 strips in the picture, whereas Fig. 5 shows only 6-1/2 lines. What actually happens is that the 525-line picture (also called a frame, named after a frame of movie film) is divided into two 262-1/2-line fields. The first field of each frame ends on a half-line at the bottom, while the second field of that frame begins with a half-line at the top. This is shown in Fig. 6, though obviously the space is not available to show all the lines.

You will note how neatly the lines of field 2 fit between those of field 1. This process is called *interlacing*, so that a normal TV picture is said to be *interlaced*.

To understand why interlacing is needed, let's consider movie film. In order to show motion on the screen, the movie projector projects a series of slightly different frames on the screen, at the rate of 24 frames per second. But if the projector lit up the screen just 24 times each second, most of us would be badly annoyed by the flicker. So the projector actually puts each frame on the screen twice, for a total of 48 "flashes" per second.

Television has a similar problem. It transmits 30 complete frames per second, but to avoid flicker has to light up the screen more often than that. It is not really practical to flash each frame on the screen twice, because then either the TV transmitter would have to send each frame twice (which would require more bandwidth) or else the TV set would have to store each frame in an internal memory so it could display it a second time (which wasn't practical decades ago when TV was designed.) So television was designed to transmit each frame in two halves—the two fields, with 60 fields per second.

Note that storage of frames was not practical years ago, but the prices of memory circuits have dropped to the point where it now is. Most computer monitors (which work on the same principles as those of a TV set), therefore, do not use interlacing.

So let's put some of the numbers back together:

- There are 30 frames per second. (In a color picture, there are 29.97 frames per second, or 0.1% less.)
- There are 60 fields per second (or 59.94 fields per second in color). This means that the electron beam moves up and down 60 times per second in the picture tube.
- Each frame contains 525 interlaced lines, or 262-1/2 lines per field.
- The 525 lines of a frame repeat 30 times per second, so there is a total of 525 X 30, or 15,750, lines per second. Thus the electron beam moves left-right a total of 15,750 times per second (which drops slightly to 15734.25 with color.).

Remember that the beam motion must be completely synchronized between the camera and all TV receivers watching that channel to make sure that all objects appear in the right place on the screen. Making all of these beams move together requires that the beam motion circuitry in every TV set is synchronized with the camera. Let's look at Fig. 7, which is a very simplified block diagram of a typical black-and-white TV set.

The signal coming in from the antenna goes through a box labeled "Tuner, etc." There is actually a lot of circuitry in this box; however, because we're not nearly ready to discuss it, let's just say that this is where the signal is amplified, and the particular channel is selected. The signal then goes into the video detector, whose output is a signal called *composite video*. This signal is in turn sent to the sync separator, which separates the composite signal into three parts: video, horizontal sync, and vertical sync.

The video signal contains the actual picture information, including whether a particular pixel should be light or dark; it also tells what color that pixel should be, except that we are limiting ourselves to a black-and-white TV for now. This signal is amplified by a videoamplifier and sent to the picture tube.

Meanwhile,. a beam of electrons travels from the electron gun to a layer of phosphor material on the screen. Whenever the electron beam hits the screen, the phosphor material lights up to produce a visible spot. You can vary the brightness of that spot by changing the strength of the beam; that in turn is controlled by the video signal from the video amplifier.

The motion of the electron beam (or beams in color) is controlled by the horizontal and vertical *deflection circuits*, which consist of two oscillators, two amplifiers, and the *yoke*.

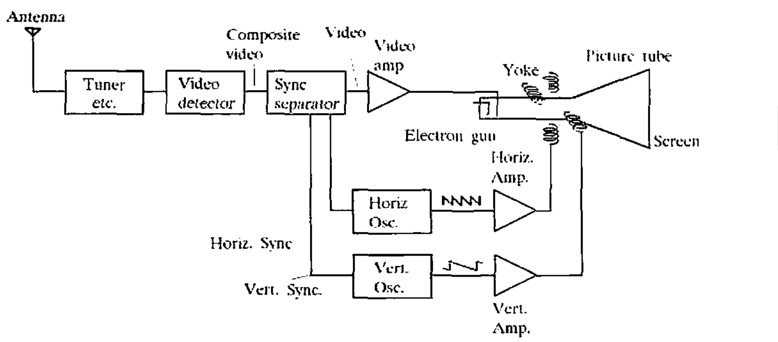

Fig. 7. Black-and-white TV block diagram.

The horizontal oscillator produces a sawtooth wave at a frequencyof 15,750 Hz. This signal is amplified by the horizontal amplifier, and sent to a pair of coils in the yoke. The yoke looks like a doughnut-shaped ring that is slipped over the neck of the picture tube. It contains four coils that produce a magnetic field as current flows through them. Two coils, positioned above and below the neck, move the beam left and right, while the other two move it up and down.

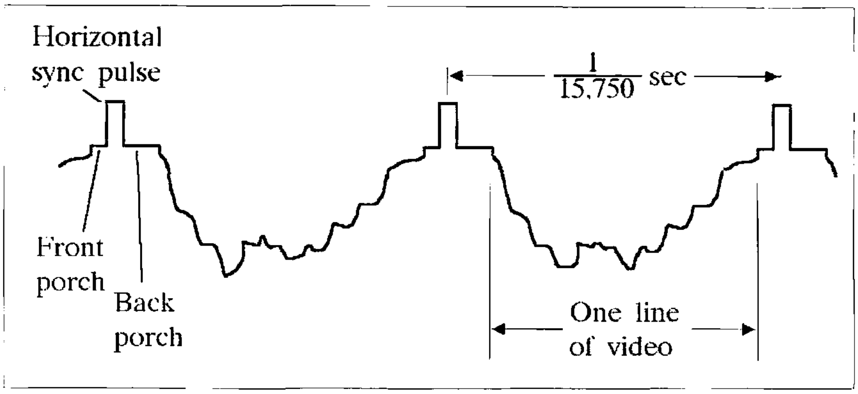

Fig. 8. Composite video signal.

DETOUR

Detour 1

We've been avoiding discussing color for awhile, but since we have to cover it eventually, here goes.

In a color set, there are three video amplifiers and three electron beams in the tube, one for each of the three colors (red, green, and blue.) There are also three color phosphors on the screen, with a "shadow mask" behind the screen that masks the screen so that the red beam can reach only the red phosphor, and so on.

If you look at a color set's screen with a magnifying glass, you can see the tiny color dots (or sometimes stripes) that make up the picture. But if you lean back, the tiny color dots blend together into other colors. For example, when a red dot, a green dot, and a blue dot are all lit up next to each other, from a distance their colors add up to produce a white dot. A red dot and a green dot together, without blue, produce yellow. The various colors on the screen are thus put together out of various combinations of tiny red, green, and blue dots.

Normally, all three electron beams move across the screen together, but their intensity varies depending on what the color is supposed to be at that point.

END OF DETOUR

The sawtooth horizontal sweep signal is sent to the two horizontal deflection coils in the yoke. The sawtooth voltage sweeps the beam from left to right, and then suddenly swings it back to the left (the retrace) in preparation for the next sweep line. Since the beam is normally turned off during that retrace sweep, it can't be seen during that return trip.

Meanwhile, the vertical oscillator produces another sawtooth wave, but this one at 60 Hz. It too is amplified, and then sent to the vertical deflection coils in the yoke. It sweeps the beam slowly down (in about 1/60 of a second), and then rapidly returns it to the top. Again, the beam is turned off during this retrace, but if you turn up the brightness on your set, you may be able to see the beam as it returns to the top. (Actually, it doesn't return to the top fast enough, so you can see it swing back and forth a few times as it returns to the top.

The two oscillators run even if you don't tune in to a working channel. This makes sure that the beam continues sweeping across the screen, rather than settling in the middle of the screen and burning the phosphor at that spot because of too many electrons. But they may not run at exactly the right frequencies, since the components in the oscillators are not precise enough to maintain the right frequencies themselves.

The job of maintaining the exact right frequencies and phases is handled by the horizontal and vertical synchronization (sync) signals, which come from the sync separator. These sync signals originate at the TV studio (typically, a single sync generator in the studio would feed all the cameras to make sure they all sweep at the same time: this is required to allow smooth switching from one camera to another), and are transmitted as part of the TV signal. The sync separator strips them from the composite video signal and sends them to the appropriate oscillator.

Let's return now to the composite video signal, the signal that comes out of the video detector in Fig. 7 to the sync separator.

If you look at the composite video signal with an oscilloscope, you see a signal that looks something like Fig. 8.

Fig. 8 shows three horizontal sync pulses, each separated by 1/17,500 second, the time for one horizontal line. Each of the pulses sits on top of a *pedestal*, which consists of a *front porch* and a *back porch*. The jagged line between any two horizontal sync pulses represents the video signal for one sweep line. As this figure shows, two consecutive sweep lines are generally somewhat similar to each other, though not identical, because they are essentially almost-adjacent strips of the same picture. (I say "almost adjacent," because they are separated by one strip from the interlaced second field.)

The voltage of the video information represents the brightness (also called the luminance) of the picture. In Fig. 8, black is up, near the sync pulses, while white is down, and there are various shades of gray between. This polarity makes the most sense when we talk about a pedestal; keep in mind, though, that most transistor amplifiers invert their signal; thus, depending on where you connect the oscilloscope, the signal may be either as shown in Fig. 8, or upside down (with the sync pulses pointed down, and white being up.) For example, the standard output of a VCR's or camcorder's VIDEO OUT jack is an upside-down signal, with the tips of the sync pulses being down at 0 volts, and the white peaks of the video signal at approximately +1 volt.

A vertical sync pulse occurs once every every 262-1/2 horizontal sync pulses.The shape of this sync pulse depends on the circuit that generates it. In commercial TV, it looks like a half-dozen horizontal sync pulses strung together, with some extra short pulses before and after them; this is often called a *serrated* sync pulse (like the serrations in a steak knife.) In computer monitors (which are usually not interlaced and in which timing is not as crucial), the

vertical sync pulse is often just a single, but very long, pulse.

DETOUR

Detour 2

In the absence of the sync signals—for instance, when you're not tuned to a working channel—the vertical and horizontal oscillators "free-run," meaning that they oscillate without being synchronized to a station. If the free-running frequency is not close enough to the frequencies required by the station, however, the sync pulses may not be able to synchronize them. Hence, most TV sets have a pair of controls, called VERTICAL HOLD and HORIZONTAL HOLD, which bring the free-running frequency into range. You may have noticed what happens when you misadjust these controls.

When you turn the VERTICAL HOLD control off its normal setting, the vertical oscillator's normal frequency varies out of range of synchronization, and the oscillator suddenly oscillates at the wrong frequency. When this happens, the vertical position of the picture will be wrong, and it may roll up or down, depending on which way the control is set.

When you turn the HORIZONTAL HOLD control away from its normal setting, the horizontal oscillator changes to a different frequency, and parts of the picture move left or right. This normally slides the picture sideways and then suddenly tears the picture into diagonal bars.

In addition to VERTICAL SIZE and HORIZONTAL SIZE controls (which vary the gain of the vertical and horizontal amplifiers to make the picture larger or smaller), many TV sets also have a VERTICAL LINEARITY control. This control changes the shape of the sawtooth vertical sweep control, and results in the top of the picture stretching or shrinking a bit. This control is normally set to make people's heads appear the right size.

END OF DETOUR

The pedestal looks somewhat different in a color signal, because the back porch contains nine cycles of a 3.579545-MHz signal called the *color burst*. The color information is carried on a 3.579545-MHz "subcarrier" (we will define that word later) and the color burst is used to synchronize a color oscillator in the TV set. (If you've seen cheap 3.579545-MHz crystals in the Radio Shack catalog, now you know where that crystal is used.)

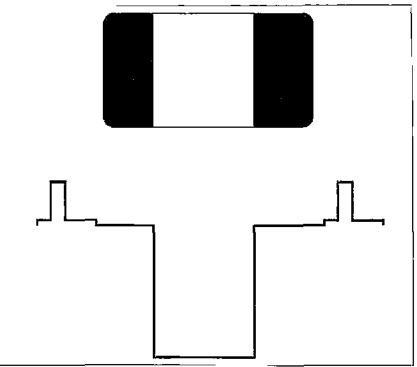

Fig. 9. A TV picture with one white bar.

Bandwidth

Let's return to the question of bandwidth of a TV signal. Suppose we aim a TV camera at a black sheet of paper containing a thick, vertical white bar, and look at the resulting composite video signal; we will see something like Fig. 9.

The top of Fig. 9 shows the screen, while the bottom shows one line of the composite video signal. Since the picture is identical from top to bottom, all the scan lines will look the same.

What we now want to ask is this: What is the spectrum of the composite video signal?

With some fancy mathematical analysis, we could come up with an exact answer. But we needn't go that far if we're willing to accept an approximate answer instead of the exact numbers. Looking at the video signal, we see a signal that, except for the horizontal sync pulse, would look like some sort of a square wave. Its frequency is 15,750 Hz, the same as the frequency of the sync pulses. Since the sync pulse is relatively small compared with the rest of the wave, ignoring it will produce an error in our answer, but not a tremendously large one.

But we already know what makes up a square wave: a fundamental plus odd harmonics. Hence, this signal consists of a 15,750-Hz fundamental, plus harmonics at multiples of 15,750 Hz (but, since the signal is not exactly a square wave, there will also be even harmonics). There will (at least theoretically) be an infinite number of harmonics; however, after the first 100 or so harmonics, their amplitudes will be so small compared with everything else that we might as well forget about them.

Let's now increase the number of bars from one to three, as in Fig. 10.

As before, we can again approximate this signal with a square wave (and even more accurately, because the sync pulses are now even smaller than all the rest of the signal), but this time the frequency is three times higher than before. A square wave with a frequency of 3 x 15,750 Hz, or 47,250 Hz, now consists of a fundamental frequency of 47,250 Hz, and odd harmonics starting at 3 x 47,250 Hz.

In the same way, we could extend our process to as many bars as we want. For example, if there were 300 vertical bars on the screen, then the fundamental frequency of the square wave would be 300 x 15,750 Hz or 4.725 MHz, and the harmonics would start at approximately 14 MHz.

There is only one problem with this idea. If you look at Fig. 2, you see that the received TV signal has to go through the box labeled "Tuner etc." And this part of the TV set generally has a maximum bandwidth of about 4 MHz (depending on the set, with color sets being somewhat worse than black-and-white sets.) In other words, our TV picture with 300 vertical bars will not get through that part of the set because even the fundamental frequency, the lowest frequency in the video signal, lies above 4 MHz!

Even a picture with just 100 bars would have some difficulty. Its fundamental frequency of 1.575 MHz would make it, but even the lowest harmonic, at 4.725 MHz, would not. In other words, the square wave video signal would be reduced to a sine wave. As a result, the signal would gradually change from white to black, or from black to white; on the screen, the edges of the bars would appear blurred.

The bandpass of the "Tuner, etc." part of the TV set puts, therefore, a basic limit on the number of vertical bars we

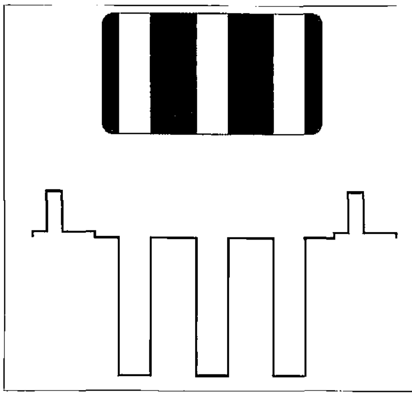

Fig. 10. A TV picture with three white bars.

can display, sharply or not. This limit varies with the set, but is about 250 lines. We call this the horizontal *resolution* of the TV picture.

It happens that the vertical resolution of a TV set is also about 250 lines. Of the 525 sweep lines on the screen, a bit under 500 actually appear on the screen (the others are either above or below the borderof the screen, or else occur while the beam is returning from the bottom back to the top). If these 500 or so lines alternated between one white, the next black, and so on, then the maximum we could get would be about 250 white lines separated by 250 black lines.

It *is* possible to get somewhat better than 250 lines of horizontal resolution on a TV screen, but only by bypassing the "Tuner, etc." portion of the TV set. Many TV sets permit that by having a composite video input jack, or even better, separate connectors for video and sync signals. Many camcorders, VCRs, and laser disks offer better than 4 MHz bandpass, and can therefore provide a sharper image, but only when they are connected directly to these special video input jacks.

Bandwidth thus affects not just the sharpness or resolution of theTV picture, but also the speed at which TV pictures can be sent. The number of lines could be increased either by increasing the bandwidth or by slowing down the transmission so that the entire horizontal line would take longer. For example, the fax machine achieves much greater horizontal resolution at a lower bandwidth by taking more than 1000 times as long to send one line of video.

Or consider TV pictures sent back from a spaceship to Jupiter. Since a wide-bandwidth signal picks up much more noise, space TV signals are sent at a very low bandwidth to minimize this noise. As a result, they must be sent very slowly to maintain any reasonably good resolution. It often takes several minutes to get one picture.

Color TV

When color TV first started, there were very few color receivers, and very few stations transmitting color. So color TV was originally designed to be completely compatible to make sure that customers with black-and-white sets could receive the color stations, and vice versa.

In color TV, everything happens exactly 0.1% slower; there are 29.97 frames per second instead of 30, and the horizontal frequency is 15,734.25 Hz instead of 15,750 Hz. So the composite video signal consists of 15,734.25 Hz and its harmonics.

Let's take a look at two specific harmonics: the 227th harmonic (at 227 x 15,734.25, or 3,571,674.75 Hz) and the 228th (at 228 x 15,734.25, or 3,587,409 Hz). Neatly sandwiched between those, at 3.579,545 MHz, safely out of the way so it won't interfere with either harmonic, is an added signal called the *color subcarrier*. This is a weak signal, carried as part of the color composite videosignal, whose phase at any instant tells the color TV set what color to make the screen at that instant. (A modern black-and-white TV ignores this signal, though early sets used to display a tiny herringbone pattern on the screen when watching a color signal.)

We've already mentioned the color burst signal, a short burst of 3.579545 MHz that sits on the back porch, just after the horizontal sync signal. The color set has an internal 3.579545 MHz oscillator; the color burst synchronizes this oscillator so it is in phase with a master color oscillator in the TV studio. To decide on the exact color to put on the screen, the set compares the phase of this local oscillator with the color subcarrier.

Digital TV

The method we've described up until now is called the NTSC method, named after the National Television System Committee, which defined the method back in the 1950s. It is purely analog; that is, no digital computer circuitry is involved. Keep in mind that computers were in their infancy, and very, very expensive at that.

In 1990, however, while the FCC was considering establishing a new TV service called HDTV, or High Definition TV, a proposal was made for an entirely digital system. Several other companies jumped on the bandwagon, and the current HDTV system design comes from a group called the Grand Alliance: AT&T, General Instrument, MIT, Philips, Sarnoff (the old RCA Laboratories), Thomson, and Zenith.

The Grand Alliance team was formed after several different groups proposed several different (and incompatible) schemes. Rather than give anything up when they merged, they incorporated everything into the final HDTV proposal. So the HDTV system includes six picture formats:

frames/sec	scan lines	resolution	interlaced
60	720	640	no
24	720	640	no
30	720	640	no
30	1080	960	yes
24	1080	960	no
60	1080	960	no

Table 1.

The rationale for including all six formats is that different formats could be used for different types of programs. For example, movies (which run at 24 frames per second) would not have to be converted to 30 frames per second, as happens now.

The HDTV system also includes five channels of sound for stereo and surround sound, and even provisions for extra data channels for sending computer data.

If all of this were done with analog methods, the bandwidth would be much larger than current NTSC television, which would mean a reduction in the number of TV stations allowed. But sending the pictures digitally allows digital compression methods to be used. For example, since two consecutive picture frames tend to be very similar, TV stations could transmit just the differences between them. The digital circuitry in the receiver would then insert the changes into the preceding frame, stored in digital memory, to make the new frame.

As a result, the complete HDTV picture would fit into the same channel format as current TV. Although you would need a new (and much more expensive) TV set to receive HDTV, there would be a period of transition when both NTSC and HDTV stations would transmit at the same time. The hope is to be able to sandwich HDTV signals into the unused channels between current NTSC stations, without causing interference in either direction.

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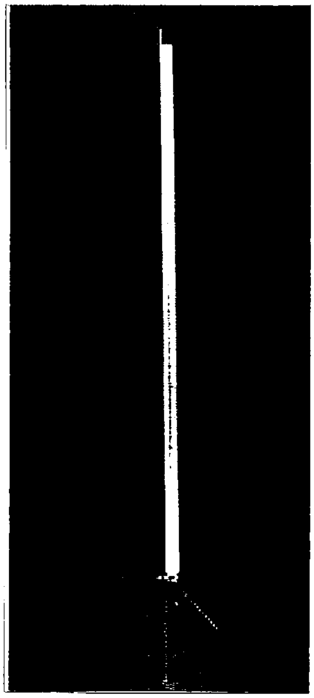
Number 72 on your Feedback card

NEW PRODUCTS

Low Profile 2m-70cm Antenna

The Genesys G-1, from Genesys Products Group, provides 3 dB gain on 146 MHz and 6 dB on 446 MHz. It's 42" high, and has three ground-plane radials and an SO-239 UHF connector. It has a white fiberglass top and an aircraft aluminum base. It comes with U-brackets that will fit up to 2.5" masts. List price: $99.95. For more information, circle Reader Service No. 202.



The Genesys G-1.

A New Battery!

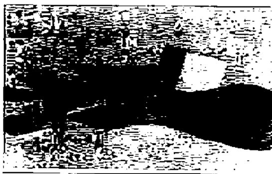
Bolder Technologies has come up with a new lead-acid battery design that looks like a real winner for applications requiring a lot of current and a short recharge time. They've made their cells much like a capacitor, using thin lead foil and an electrolyte instead of a dialectric material between the windings. Each cell is about 1" x 3" and provides about 2 volts. These are going to be very useful for power tools, uninterruptable power systems (UPS), portable equipment, electric scooters, and even cars. A battery weighing less than two pounds can start a car 20 times on a single charge! Being lead-acid, it doesn't have the memory problems of NiCd batteries.

One other factor is that there is a well established recycling industry for lead-acid batteries, and none for the far more toxic cadmium or lithium.For more information, circle Reader Service No. 204.

Manufacturers please send your products to be reviewed to Richard. Call 603-924-0058 for details.

Dalco Data Protector

Don't you hate it when you are online with your computer and someone picks up another extension and starts dialing, destroying your connection? Dalco to the rescue with their Data Protector™, a $17 gadget that disconnects other extensions when you are using the line. It'll stop any eavesdropping too, if that's a problem. Discounts on the purchase of three or more units. For more information, circle Reader Service No. 203.



Dalco Data Protector

Hidden Antenna Kit

Just the thing for cliff dwellers and covenant-restricted hams. Check out the TapeTenna from Hamco, with 108 feet of half-inch wide copper foil tape, connectors, and an instruction book. The tape will stick to just about anything, indoors or out. You can even paint over it to make it more invisible. It's $34 ppd. That's cheaper than moving to a more ham friendly QTH. For more information, circle Reader Service No. 201.

ABOVE & BEYOND

Continued from page 64

You would not want to pick up a laser head that was miswired. External power supplies providing the several thousands of volts needed for the operation of a laser head provide a ground to the negative portion of the power supply. I have found this wire to be somewhat small gauge and prefer to operate my systems with a much larger system ground that ties common with the power supply and laser head. A sturdy copper braid like coax shield has been successful. The braided shield provides a great deal of flexibility and a sturdy conductor. Whatever you use make sure your equipment is grounded and that the protective case ground is just that: *ground*. A new laser can be obtained but there is only "*one of you.*" Safety First!

Laser Power Supplies

There are several different types of laser power supplies available. They range from units that can be operated from 110 AC to 12 volts DC input. For our applications the 12-volt DC supplies are the most desirable. These supplies make portable operation possible without DC-to-AC inverters and long power cords. Though it is possible to build a switching power supply using a single toroidal cup core transformer with a 12-volt primary, I found the winding process quite tedious. Think of it with 30 or so turns at 12 volts. How many turns does it require to obtain something near 1500 volts?

I tried constructing a 12-volt laser power supply using a large cup core transformer scrounged from surplus PC boards. The cup core was an inch and a half in diameter and one inch high. I wound the primary with 60 turns, center tapped, which filled one layer of the cup core. I insulated the cup core from the primary with Teflon™ tape used for plumbing applications. I overwrapped the primary winding to further insulate the primary and secondary with the same Teflon™ tape using several layers of tape. I then started to wind the secondary with #40-gauge insulated wire. I have to admit I lost count of the turns on the secondary several times as winding some 600 turns proved to be harder than I had thought.

Now the final scenario. After locating high-voltage rectifier diodes (not the 1,000-volt variety but 10,000 volts) and some capacitors rated at 3,000 volts, you can expect a good dent in your pocketbook. Why these high-voltage components? Well, this is part of the extra circuitry that needs to be applied to a laser power supply to provide something over 1,000 volts at a few mA. What is needed is a circuit added to the high-voltage path to provide a 10,000 or so peak starting voltage when the laser supply is first turned on, to ionize the gas in the laser head. After the laser is ionized the lower voltage will sustain the ignition and operation of the laser.

The ignition circuit is nothing more than a series voltage multiplier that boosts the 1 kV DC to about 10 kV for a very short interval only, when the laser is off and just before it ignites. When the laser ignites, this circuit self-disconnects electrically, allowing the low-voltage power supply to flow through this network. The circuit does not function as a multiplier, but rather like a series pass element. The multiplier will only function at microamp current

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Communications

Continued from page 71

One interesting aspect of HDTV is that, although it is very different from NTSC, it has been purposely designed to be compatible with computer applications. The idea is that the same HDTV sets could also be computer monitors. Since the digital transmission method used for HDTV can accommodate digital data as well, there is an underlying hope that television and computers will merge into the ultimate tool for the "information superhighway" of the future.

Summary

Although this part has just been a limited introduction to television, it has covered several important concepts. Aside from an idea of how TV works in general, we have once again seen the impact of bandwidth on the transmission of information, and also once again seen the interaction between bandwidth and time. Although we haven't provided any definite proof (that would require some advanced math concepts), we still begin to see that bandwidth is a necessary part of communications. If a signal has no bandwidth, then it cannot transmit any information at all.

Hamsats

Continued from page 54

of 10 in the last 30 years, and the sophistication of the payloads has paralleled that of electronics advances over the same period. The equipment in the control room reflected the high level of technology required for flight control and monitoring.

Dwight showed the group a telemetry support package that straps onto a customer payload. The telemetry unit weighed a few hundred pounds and included the equivalent of a Pentium PC ruggedized for the rigors of high-altitude flight.

Getting a huge balloon and massive payload into the sky is a complex job. Winds must be below a few miles per hour and several vehicles are needed at the launch site. A minimal launch requires a helium truck, a spooler vehicle to deploy the balloon and lines, and "Tiny Tim." Tiny Tim, at the NSBF, is an electrically powered vehicle that holds the payload, and can be maneuvered under the balloon during launch so that the balloon, parachute, lines, and the multi-thousand-pound scientific package take off straight up. Just standing next to Tiny Tim gives a sense of how large the payloads can be. The wheels on the vehicle are nearly seven feet tall.

There were no launches at the time of the tour, but the public is welcome to watch from nearby roads when one does occur. Although most launches are scheduled for early morning hours or nighttime, variables such as weather conditions make it difficult to predict actual launch times. A typical launch may take two to three attempts due to conditions at the site.

One-hour tours are available by appointment and launch schedules can also be requested. If you are passing through east Texas, stop in Palestine. A visit to the NSBF is well worth the effort. The number to call for tours or information is (903) 729-0271. For other general information about Palestine, contact the Palestine Chamber of Commerce at (903) 729-6066.

Photo E. The payload launch vehicle is electric and big, *with Mike WA5TWT (Ken Axelson photo).*

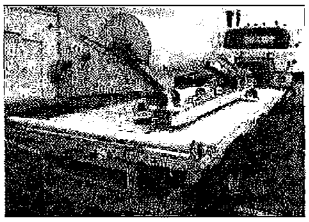

Photo F: The balloon spooling unit is required for proper balloon and line deployment during launch (Ken Axelson photo).

Never Say Die

Continued from page 4

and blinders of the establishment. Stock in the Big Bang has been dropping fast on the scientific stock market.

Okay, we have little balls of energy spinning, with the energy going around the outside of the ball and up into the center vortex and quickly coming out the bottom again. As we know from whirlpools, tornadoes, and plasmas, vortices suck. This force holds the ball of energy together. It also tends to attract any nearby energy balls, thus providing what we perceive as gravity.

"It's matter being made up of spinning energy fields which cause inertia."

In my editorials in *Cold Fusion* I've suggested a new model for the atom. I give full credit for the direction my thinking has gone to *Cold Fusion* scientific advisor M. Srinivasan of the Bhabha Atomic Laboratories in Bombay, who put me onto the book *Extra-Sensory Perception of Quarks* by Stephen Phillips. And that book drew, in a large part, on the work of Besant and Leadbeater, as reported in their book, *Occult Chemistry*, which was published in 1908. Almost a hundred years ago! Using meditation, they either were able to visualize atoms and their constituents or else they were two of the luckiest guessers in history.

The next resource for me was Eric Lerner's *The Big Bang Never Happened*. Putting the data from these two sources together helped explain for me how the coulomb barrier could be breached for the cold fusion reaction. Then, as I got to thinking more about it, this also explained inertia. I'd recently read Peter Graneau's *Newton Vs. Einstein*, which confirmed that not even Einstein was able to figure out why we have inertia.

Now, if you figure that electrons and protons are made up of smaller energy bundles which are shaped like fat spinning balls with a tight vortex in the middle, you'll get the idea. These are balls of energy, whatever that is. Now, if you spin a gyroscope you have to exert an outside force to move it, and then it will keep on moving until another force changes its motion. Just like inertia. Thus, it's "matter" being made up of spinning energy fields which causes inertia. If you have a box full of gyroscopes, all spinning on different axes, you'll cancel precession.

Physicists messing with atoms and quarks agree there's spin involved with everything. And antimatter just has a reverse spin. So when you mix the two you have all that energy suddenly released. Whamo!

Doesn't that all make sense? Now, what is this energy stuff that's spinning around?

Well, you can see why I'm having so much fun with all this. Sure, I'm probably wrong. History says so, for every atomic theory in the past has eventually been proven wrong as our ability to extend our senses with instruments has developed. And ditto our cosmological theories, no matter how fervently held. Ask Galileo.

I tried out my theories in *Cold Fusion* editorials, since they're read by many physicists. I've had some enthusiastic responses, and no negatives. That really surprised me. Well, I'm reading and learning as much as I can. How about you? Are you drinking beer and watching ball games or learning new things? I don't know of anything more fun than grasping new concepts. Well, maybe skiing like a bat out of hell down a mountain, carving those turns. Or working the only station in Iraq and having a chance to more than swap QSL information.

Speaking of Iraq, I hope I'll be able to find time to start putting together some slide shows on my computer so you can see what I saw on my visit to Iraq. I took some fabulous pictures and now I've got a J-Peg program to scrunch 'em onto a disk. The next step will be the development of a way I can send my pictures and stories over 20m. How about working on that for me? And writing it up as you progress?

Magnetic Power

There's what has given me the impression of a lunatic fringe lurking just outside the cold fusion field, probably attracted by visions of yet another source of free energy. Some of them are believers in the magical abilities of certain type of coils to generate an anti-gravity force. Others are firm believers in what they call zero-point energy. This has to do with being able to tap what they believe is an enormous amount of

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How About a 2W 40m
Continued from page 51

inside the NorCal 40A to mount the keyer/counter and make the great little rig even better.

If the new builder ends up bungling the kit, he can send it back to Wilderness and get it fixed for a flat fee of $50 plus $5 shipping, provided it is repairable. Technical support is available Monday through Friday from 10 a.m. to 5 p.m. Pacific time. The kit currently sells for $129 and is well worth the money.

I made sure I really took my time building this kit. I have learned that it takes a lot less time to build it right the first time than it does to fix it later, and there is a lot less tension produced. The NorCal 40A has a small parts count, which made this kit very easy to build.

The printed circuit board was fantastic. The silk-screening was very clearly marked so there was no doubt in my mind where each part went on the board. It was also a pleasure to solder. The board seemed to just suck up the solder. You should use a sharp-pointed soldering iron of 20 to 45 watts. When you solder remember to keep the tip at an angle and heat the soldering pad on the board and the wire coming through. Allow the solder to flow freely for a second before removing the iron. This will make for much better soldering joints. I found that even though I was really taking my time, the kit went together very quickly.

Sneaky Toroid Trick

The only possible obstacle I can see for the new builder is winding the toroids. Oak Hills has gone to providing these pre-wound. I believe that anyone can easily wind their own toroids and get a real sense of accomplishment doing so. There are easy-to-follow directions provided in the manual. The VFO toroid requires a large number of turns. I cheated. I had my wife wind the VFO coil and she did a beautiful job.

One thing I really appreciated was the quality of the magnet wire provided. I find that it is easy to wind the toroids if you take your time, but that in many cases you can easily mess up when it comes to removing the insulation on the ends that get soldered to the board. If you get too rough they tend to break. The wire provided with this kit for winding the toroids has heat-melt insulation. When you are done winding you take a lighter and melt off the insulation at the ends, then take some sandpaper and make sure they are clean. You might want to check for continuity in the sets of wires with an ohmmeter before you solder them to the boards.

When you finish most kits there are a number of wires you need to hook up to connect various controls and jacks. Since this kit had all board-mounted controls and jacks, when I was done putting all the parts on the board, I was pretty much done building. It didn't take long to mount the printed circuit board to the bottom cabinet.

The Old Smoke Test

No matter how many kits I build, I always get nervous when applying the power. It can be a bit depressing to smell smoke. Make sure you have the polarity of your power source correct. The manual provides a chart for you to check voltages should you find there is a problem. If you smell smoke, turn it off!

The manual clearly tells you to set the trimmer capacitors and variable resistors to

their initial positions. You next hook up a set of headphones that need to have a stereo headphone plug. You hook up an antenna and turn on the rig. I heard a hissing in the headphones; well, at least one part of the rig appeared to be working.

To align the receiver, you simply adjust two of the trim capacitors while listening for a signal. The adjustment is fairly sharp. When you get it right it is obvious because the signal you will hear will be a lot louder at this point. You will next need to adjust the VFO to the correct frequency. I have a frequency counter and used it, but you can do the alignment with a transceiver, preferably one with a digital readout. The rig came up close to frequency and it only took me a minute to adjust the frequency to where I wanted it. If you don't modify the rig you should be able to adjust it for any 40 kHz of the 40 meter band.

The rest of the kit was a breeze to align. You adjust a trim capacitor for the BFO pitch and set the AGC control, if you want to use it. To adjust the transmitter you adjust one variable resistor for power output. Make sure you use a dummy load or at least have an antenna hooked to the rig when keying it. I use a QRP wattmeter to adjust the power. If you don't own one you can simply adjust the control as described in the manual. A couple more simple adjustments and you are done.

Hey! It Really Works!

I hooked up the power, a small amplified speaker (I don't like headphones), the antenna and a key. I tuned around and found signals popping out clearly. The receiver seemed to hear well and was quiet. I tuned around and heard KFØN calling CQ. I gave him a call and he immediately came back to me. Larry was located in Cedar Rapids, IA. I was using less than 2 watts to a ground-mounted vertical antenna. After exchanging signal reports, names, and QTHs, he said "FB, wow! Your 2 watts doing a splendid job up here." We ended up talking for over half an hour. I noticed that the VFO on my rig was stable, so I didn't have to mess with the controls during the QSO. It turned out that Larry was on a Heathkit HW9 running 4 watts. I took this as a sign from above. My favorite QSOs now are QRP-to-QRP. We spend our time talking about QRP and various kits. It is hard to explain in words how much fun that first contact was and how loud my yell was when I first heard him come back to me.

After finishing with Larry, I worked Rich WB2VPH in Brockport, NY. I next worked Steve NØJGU/M near St. Louis, MO, and then many more contacts, one after the other. I was able to hear many stations and work all the ones I heard. I got consistently good reports on how my rig sounded and how well my signal was getting out. Who can ask for more than that?

Increasing the Tuning Range

Modifications that you can add are listed at the end of the manual. The one I did was to replace the 47 pF NPO capacitor in the VFO circuit with a 56 pF NPO. This gave me 60 kHz of coverage from 7.000-7.060, which is all I use of the band. This modification causes the RIT to have a greater range. You can simply change the value of this capacitor while building the kit. Make sure you use an NPO capacitor to maintain the stability of the VFO. There is plenty of room in the cabinet to put in a 10-turn pot which will increase the VFO range up to 150 kHz to get the full CW band coverage.

The bottom line is that this is one great kit. It was a lot of fun to build and it really works. The receiver is both sensitive and selective. My rig has a very stable VFO so that I stay on a given frequency. The 1.8 watts seems to be enough for me to work most everything I hear. The rig is very small and can run for quite a while with a small gel cell. This makes it an excellent backpacking rig. I find one of my greatest enjoyments in ham radio is talking to other hams using battery power on a little transceiver that I built myself. 73

The Details

DC Power Requirements: 10 to 16 VDC: reverse-polarity protection
- Receive: 15 mA
- Transmit: 225 mA at 2.0 watts output

Frequency Coverage: VFO operating frequency: 2.085 MHz nominal
- Covers any 40 to 45 kHz segment of the 40m CW band (7.0-7.15 MHz)
- Drift: 100 Hz total from cold start at 65 degrees F

Transmitter: Output: 0 to 2 W, adjustable
- Final amplifier efficiency: 70-80
- Load tolerance: Brief operation into high SWR
- Transmit offset: 400-800 Hz, adjustable
- Transmit-receive delay: 200 milliseconds

Receiver: Sensitivity: Better than 0.5 uV for 10 dB S+N/N
- Selectivity: 400 Hz @ -6 dB, 1.5 kHz @ -30 dB
- IF: 4.915 MHz, 4-pole Cohn crystal filter
- RIT Range: +/- 2 kHz at center of VFO tuning range
- Audio output impedance: 8 ohm or higher (head phones or speaker)

You can join the Northern California QRP Club-NorCal for $10/year US. This includes a subscription to *QRPp*, which is published four times a year. Write to: Jim Cates WA6GER, 3241 Eastwood Rd., Sacramento, CA 95821. You must be a member to purchase their projects.

NEVER SAY DIE

Continued from page 74

energy that exists in the "ether," a.k.a., space. Not being able to grasp the concepts involved, I've been awaiting something more substantial than the emotional writings of the True Believers to convince me, thus irritating the hell out of them. But then I've never been swayed by the emotional attacks from True Believers, whether they be proselytizing or defending a religion, the ARRL, CW, or some imagined potential ecological disaster.

If these so-called "N-machines," which are powered by magnets, are so great, let's see one working, was my approach. A reader from California called to say that he had followed up every reported working N-machine in the world and had yet to find one that would work when he was watching.

Thus, when I recently got a press release about a coming demonstration by Yasunori Takahashi of a working N-machine in Switzerland I faxed the London source of the release, asking for more information. I remembered getting a story several months ago about a Takahashi magnetic motor and its use in a scooter, so this seemed worth looking into. A return fax said the Swiss demo had been canceled. Hmm.

A few days before Thanksgiving Sherry said why don't we zip over to London for the weekend? We'd done this several times in the past, flying over on Wednesday evening and back on Sunday, thus not missing even a day's work. Several airlines have amazingly low cost package tours...if you call around $600 for the round trip, including ground transportation, hotel, and a London show, low cost. That's about what it would cost to stay in a New York hotel for three days, and never mind the meals. So I set up a meeting with the London Takahashi representative for Friday.

"Perpetual motion seems to be here. This is obviously impossible."

We'd gone via TWA in the past, but this time we tried British Air. Never again. Oh, the trip over was all okay, but they got us to the Royal National hotel by around 9 a.m. Thursday and the crummy hotel wouldn't give us a room until after 2 p.m. Not having been able to get much sleep in the cramped plane seats, we were in lousy shape to sight-see London. We wanted to sleep!

We took the underground downtown to see some tourist attractions for which we'd been given free tickets. When we got to the Tower of London, it was closed. Ditto the Banqueting House. We did see a few minutes of the Queen's Horse Guards on parade, and then we

walked a couple of miles back to the hotel, checking on what shows were running as we passed the theaters. None of the shows looked very good so we tossed a mental coin, which came up tails, and traded in our coupons for tickets to "Funny Money." When we got back to the hotel we sat. And sat. At two we got our room and crashed, leaving a call so we wouldn't miss the play.

The play was surprisingly terrible. I've seen far better on some silly British shows on PBS. But it wasn't much worse than the show we caught when we stopped by London on our way to Paris and Monaco for the March cold fusion conference. It was a comedy. I almost laughed a couple of times.

The next morning we went down to the hotel's $18 English breakfast which was included free with the tour. Major bummer. The oatmeal was cold. The poached eggs like rocks. The toast cold. The bangers yuuck. The stewed prunes hadn't been stewed. The OJ had a slight orange flavor.

We've done this London Thanksgiving tour thing many times, and TWA has always put us in top-notch hotels with superb food. Thanks BA for finding this hellhole for us. Everything about the hotel was cheap and shoddy.

After we recovered from the breakfast we took the underground to the suburbs and were met at the station by Takeo Sawai, who drove us to his home. There I was introduced to the Takahashi scooter. It had a small battery, used to get it started. Once running, the electric motor-generator takes over and runs the scooter, as well as recharging the battery. Yep, the motor runs a generator which then completely ignores the laws of physics by generating enough current to run the scooter and recharge the battery. Perpetual motion seems to be here.

This is, obviously, impossible. And the fact that the scooter could carry two heavy men uphill at a very brisk speed meant that some clever magic was being used. I put on a helmet, climbed on, and zoomed away, dodging oncoming traffic, as I sped around the London streets. Hey, this thing sure has a lot of pickup. It seems to have more power than my Yamaha scooter, which is no slouch.

The secret is in the magnets built into the motor. These are no ordinary magnets. I brought a few home to astound people with their power. I let one get within a foot of my underground ticket and it erased the magnetic stripe so the ticket wouldn't work any more.

The Background

Mr. Takahashi has some impressive credentials. He worked for Sony for several years and was involved with the development of their Trinitron, the Betamax, and the Walkman. This is not a hoaxer. Further, in addition to inventing the super-powered magnets used in his motor, he's also invented a capacitor dielectric that is unbelievable. Well, it would be except I have a copy of the patent.

The magnet came from Takahashi's work in developing high density magnetic material for videotapes. It's made of needle-shaped micro-magnets of yttrium, iron, manganese, X, which are glass-bonded. It has a coercive force of about 15 times that of alnico.

In reading the capacitor patents I found that Takahashi has developed capacitors which are 1/20th by 1/10th of an inch and have 250 µF capacity! That works out to about one Farad for an inch-square capacitor! Who needs batteries when we have such small sized capacitance available?

I hope one of these days to be able to get together with Takahashi and a good interpreter, so I can learn more about his dielectric, his magnets, and his motor-generator. I've seen it. I believe it. But I sure don't understand how it is possible.

Late news: The magnet motor has been issued a US patent (#5,436,518). In the accepted patent claims the input power to run the motor was 19.55 watts and the output of the generator was 62.16 watts. That's 318% output over input. So, though the system is obviously impossible, it not only works, but it's been patented. And I've ridden an electric scooter powered by the magnet motor-generator.

Stonehenge

On Saturday we skipped the free $18 English breakfast and went on a tour to Stonehenge. Sherry's been wanting to see the place. It was an all-l-l-day bus trip, which included stops at Bath and Salisbury. Our tour guide talked almost incessantly over the bus's PA system, giving us in a strident Julia Child's voice details of unmemorable significance on places we were passing as we drove clear across the country. We saw the rocks. No, I didn't get any feelings, other than some leg cramps and a tired bottom from sitting for hours on the bus. Don't miss Stonehenge if you go to England.

In Salisbury we visited a church where they have an original copy (is that self-contradicting?) of the Magna Carta. The Magna Carta room closed at 3 p.m....we got there at 5. Fortunately there was a symphony orchestra there practicing, so I got to show off my music recognition skills by identifying Richard Strauss's "Tod und Verklarung" for the other members of the tour group. Don't mess with me when it comes to classical music, okay?

The Fan Gets Hit

Sunday we returned home to New Hampshire. The BA meal was inedible. Sherry saved hers for the cat. I stopped by the office on the way home to pick up Friday's mail. Holy Jehosephat, there was a whole post office basket full!

On the Saturday morning before the trip I'd been interviewed for three hours by Art Bell W6OBB, who has a nightly talk radio show. I was on from 4 a.m. until 7, talking about amateur radio and other things.

I'd offered to send a 12-page booklet listing 49 books that people are crazy if they don't read to anyone requesting it. I also offered the 16-page instruction booklet on the blood purifier and a 32-page booklet of editorials I've written for *73*, but haven't had the space to run yet. I figured I'd maybe get a couple dozen requests.

Well I figured wrong. I began to suspect that when my fax machine started running through rolls of paper like a Broadway ticker-tape parade within minutes of the end of the program. Two weeks later it was still grinding out responses to the program. My 800-number at the office was lit up for a week. And then the mail started. It was only a dribble on the Wednesday I left for England. On Friday there were 257 letters.

I spent the rest of Sunday after getting back answering the requests with information on amateur radio, cold fusion, the book list, editorial packages, and blood purifier circuits.

The Monday mail was even worse. Whew! It tapered off a little on Tuesday and was down to only 60 letters by Wednesday. Helen, at the office, worked flat out making photo copies of the booklets, trying to keep up with the demands. By Friday I got 'em all answered.

By then the second wave had started to arrive. These were the orders for booklets resulting from my answers to the first requests. Subscriptions to *73* and sample copies of *Cold Fusion*. Orders for my submarine adventures in WWII book. Lots of orders for my *Declare War* book.

If I can get on a few more talk shows maybe we could get amateur radio growing again. But how about you? How about you leaning on any friends you have with talk shows to talk up our hobby. Explain how there is no such thing as a lonely ham. You turn on that switch and the whole world is yours. You turn it off and you're back alone again until you need company. Most of my friends down through the years have been hams I met on the air. Johnny Williams W2BFD, the guy who made RTTY happen. Sam Harris W8UKS/W1FZJ/W1BU, who pioneered moonbounce. Bill Hoisington W2BAV/K1CLL, who built circles around everyone else in the hobby for years. Chuck Martin WA1KPS/K1IO, who skied with me and went on diving trips for years.

Kids may not appreciate the entry into high-tech careers that amateur radio provides, but maybe their parents, who see the way the world is going, may encourage them. Ham radio did it to me and I don't regret one minute of it.

Amateur radio has provided me with a lifetime of adventure and unlimited career opportunities. Ham radio got me my first job as a technician at GE, testing the BC-191 and BC-375 command transmitters, back

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Above & Beyond

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levels. When high sustained laser current (ignition) is running, the multiplier becomes bypassed series diodes, creating a very small voltage drop.

Well that's it for this month. Next month I plan to cover the laser power supplies and other components.
73 Chuck WB6IGP

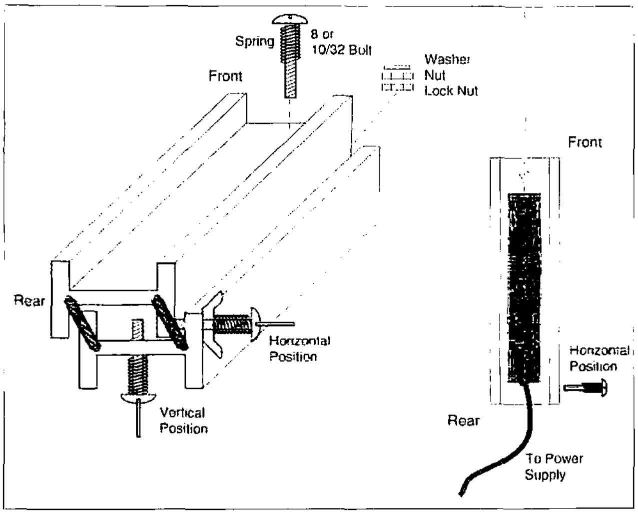

Fig. 3. Complete drawing of the laser carpenter level mount.

Number 78 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Monitors

If you've been to any hamfests in the last five years, you undoubtedly have noticed that they tend to be filled with more computer gear than radio equipment! I suspect most hams are computerniks, and the two do go together rather well. Although I see lots of PC clones and even a few Macs, the one thing I see more of than anything else is monitors. There are all kinds of monitors at bargain prices, including monochrome, CGA, VGA and SVGA. Some have coarse dot pitches, which may be the reason the seller is getting rid of them. Others may have nice, .28-mm dots, making them excellent choices for today's high-resolution computer displays. How can you discern the dot pitch? It takes a little practice to get good at judging them, but there are two ways to tell: First, look at the monitor's model number. Usually, the last numbers in it give the dot pitch. So, an SV 29N has a .29-mm dot pitch, which is pretty good. A VL-4539, though, would have a .39-mm dot pitch, which is pretty ugly. If there's nothing obvious from the model number, take a good look at the screen. With a working monitor, it should be quite clear whether the image is made of fine dots or not. If the set is dead, though, you can still get an idea by shining some light on the screen and looking closely. If you see an obvious, square, blocky pattern, chances are the unit has an unacceptable dot pitch. If, though, you see tiny dots, and especially if they're not easy to make out, you've probably got a good, fine pitch and will be happy with the monitor. That is, if you can fix it!

Alphabet Soup

VGA? CGA? EGA? SVGA? RGB? Hercules? Multisync? Unlike with regular TV sets, there are lots of different signal standards for computer monitors, and the one you buy must match your computer's signal or you're out of luck. What do you need? Most PC clones today use VGA and/or SVGA. If you have an old XT, it may need CGA. Take a look at the video connector. If it's a nine-pin, it's probably CGA, although it could be Hercules. If it's a high-density 15-pin, chances are it's VGA/SVGA. Naturally, be sure the plug on the monitor you're looking at matches the one on your computer!

If you're a Mac user, you have several options. although Macs are made for use with Apple monitors, which have a different scan rate from the IBM standard, many multisync monitors will work, as long as you procure or make the required plug adapter. Even better, many newer Macs can use regular, non-multisync VGA and SVGA monitors! All it takes is a plug adapter cable wired with a specific connection that tells the Mac it's connected to a VGA monitor. From my experience, even many Apple dealers don't know that. Not all Macs can do it, though, so check the manual for yours before investing in a VGA monitor. If it will work, you can save quite a bit of money, because VGA monitors cost a great deal less and are much more easily found on the surplus market.

Pick One

If you want to pay $100 to $150, you can get a monitor that works fine. Even in that price range, though, take a good look at the picture before you buy; some of those sets have been on for thousands of hours and have weak CRTs, and others have crummy dot pitches. What you see is what you will have to live with, so choose carefully, remembering that you can have a new monitor with a .28-mm dot pitch for about $225 to $250 if you're a careful shopper. In general, avoid old looking, dirty, beaten-up units, as you would with anything else. If it looks like it's spent its life in a dirty warehouse, it probably has, and you would best avoid it.

R.I.P.?

How dead is dead? If you want a monitor for $10, don't expect it to work at all. Probably, the power light won't even come on. Often, the seller will tell you that he doesn't know if it works, or that it worked the last time he tried it, but it's been awhile. Take that as hamfest code for "it's dead!" Surprisingly, there seem to be lots and lots of dead monitors out there! So, let's take a look at what you can expect to find, and how best to go about fixing those cheap, dead monitors.

Just a TV

Really, a computer monitor is nothing more than a TV set. There are a few differences, however. First, there's no tuner. Second, all that NTSC color decoding circuitry is gone—modern computers send their red, blue and green signals on separate wires. Third, there usually is no sound circuitry. So what's left?

Just the nasty stuff! A typical computer monitor consists of a power supply, horizontal and vertical scanning circuits, a high-voltage supply for the CRT, video output amplifiers (one for each of the three colors) and, of course, the CRT assembly itself, with the yoke and convergence magnets. Generally, the convergence, which is what keeps the three colors aligned with each other on the screen, is static. That is, it is accomplished by nothing more than a group of magnets around the neck of the tube. If it's a really big monitor, say 17 inches or more in screen size, it could have dynamic convergence, which is done with a bunch of circuits that generate some extra currents which are used to adjust the convergence as the beam sweeps across the screen.

Most television problems occur in the power supply, scanning and high voltage sections, so the lack of all those other circuits doesn't help us much here. Most of the dead monitors I've bought have had either blown power supplies, blown horizontal output transistors, or both. Assuming your monitor exhibits no signs of life at all, it's best to start with the horizontal issue.

But First

Before we do, though, I must warn you about something: The insides of TV sets are extremely dangerous! A typical color CRT requires about 30,000 volts at its anode (yes, you read that right!), and other voltages ranging into the thousands at other terminals. There's plenty of current, too, so you can be killed if you're not careful. Also, the picture tube itself is fragile enough that you can break it with a dropped tool, and its high internal vacuum can make it implode like a bomb, causing just as much personal injury as an explosive device. Be *careful!* Always shut the power off and pull the AC plug before disconnecting or replacing anything, and try to avoid disconnecting the anode lead from the picture tube. If you absolutely must do that, remember that the tube is basically a big capacitor which can store enough high voltage to finish you off. Discharge it by connecting a clip lead to the set's chassis and then connecting the other end to a screwdriver with an insulated handle. Now, touch the tip of the screwdriver to the inside of the dimple where the anode clip was, and hold it there for about 10 seconds.

Pop Goes the Output

Nothing in any TV set works as hard as the horizontal output transistor, so nothing blows out as often, either. This is a special, high-voltage, high-current transistor which generates not only the horizontal scanning signal, but also the high-voltage supply for the anode of the CRT. In some sets it generates many of the lower voltages as well. You'll find the part clamped or screwed to a big heat sink which is nearly always right next to the flyback. What's a flyback? That's just an old TV service shop name for the high-voltage transformer. It's easy to locate because its output lead is the thick one that goes to the side of the picture tube. Follow that lead back and you'll find the flyback and the horizontal output. Because they're multi-layered inside, horizontal outputs have a great deal of voltage drop and usually won't test properly on an ohmmeter or a garden-variety transistor tester, so don't bother to try. When I get a dead monitor,

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Number 79 on your Feedback card

Homing In

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton CA 92633

New T-Hunting Goodies

"You never know where you'll end up and you never know what you will find." That's my standard answer when someone asks why I still enjoy hidden transmitter hunting after doing it regularly for almost 20 years. The outcome of a radio direction finding (RDF) contest (usually called a T-hunt or foxhunt) is seldom predictable. Hiders have an endless variety of places to put radio foxes, and they're always coming up with new ways to disguise them.

You may have to drive several dozen miles in the right direction to get to the hidden T site, but that doesn't mean it will be in plain sight when you arrive. Sometimes the greatest challenge comes when your car reaches the end of the road and you have to finish on foot. You need good RDF gear for this part of the hunt (sometimes called the "sniff"), because your eyes can be deceived.

On one of my first transmitter hunts, the signal led me to a street of new homes in Phillips Ranch, California. Each had a very large front yard with a rural mailbox at the curb. The hider and his distinctive jeep were nowhere to be seen and no radio gear or antennas were visible. Several T-hunters were wandering around, finding nothing out of the ordinary.

RDFers who performed careful close-in triangulation while rolling their cars slowly down the street soon discovered that the signal was very strong in the vicinity of one mailbox. Upon closer inspection, they realized that the name on the box was "T. Hunter" and the transmitter was inside! Hider Rich Krier N6MJ had put a handie-talkie, battery pack, and tone box into a standard rural mailbox, then painted and placed it to look like all the others. He had drilled a hole from the box interior into the 4" x4" wooden mounting post and lowered the antenna into it. The whip was perfectly concealed, yet it put out a good signal.

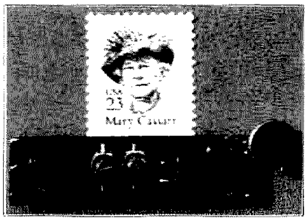

Photo A. The Agrelo Engineering HPVFC micro-transmitter is factory-tuned into a 50-ohm load with the trimmer capacitors on this side of the board. On the other side are 46 SMT components.

Since then I have enjoyed the fun of hiding tiny transmitters in unexpected places and watching T-hunters try to find them. This kind of T-hunt is popular all over, as evidenced by a recent Internet posting by Bruce Paterson VK3TJN. It told of a November 1995 hunt near Melbourne, Australia, that was put on by VK3VR, VK3MZ and VK3TVB, the current Australian champions.

VK3TJN wrote, "Any observers watching the conclusion of the next event would have seen a number of hounds madly rummaging around in shredded wood surrounding a climbing frame in a playground. Those with keen eyes would have noticed that a nearby wooden log had a hairline crack around it, as it had been hollowed out to fit a small transmitter inside. Four teams had managed to recognize this and then check in, before the cry of 'It's in the log!' from one jubilant hound shattered the silence."

Move Over, 007

Today's Surface Mount Technology (SMT) has made it possible to shrink a fox transmitter to the size of a pack of gum. The N6MJ mailbox trick could now be done with the entire transmitter inside the post. Hunters opening the mailbox door would see nothing at all!

"Homing In" for May 1993 featured construction plans for the smallest 2 meter FM transmitter board I've seen, designed by Ken Bauer KB6TTS. Small enough for two to fit side-by-side on an Elvis stamp, it puts out about 25 milliwatts with a 9-volt supply. I keep this transmitter, plus a tiny CW ID unit (reviewed in "Homing In" for August 1993) and a 9-volt transistor radio battery, in a small pill bottle. It goes with me whenever I talk to a ham club about T-hunting. Usually somebody hides it nearby and everyone gets a chance to try on-foot foxhunting with their handie-talkies and the "body shield" technique.

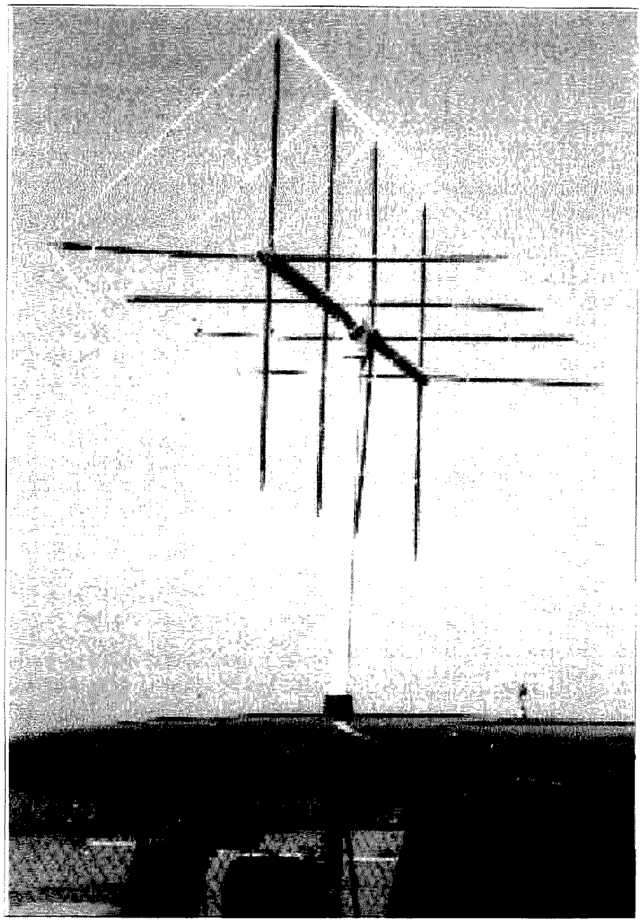

Photo B. The Cubex Yellowjacket four-element 2 meter cubical quad received a thorough test on my T-hunting van.

This tiny T has been one of the most popular "Homing In" projects to date. One ham who was especially impressed by it is Joe Agrelo N2OOC. He is the owner of Agrelo Engineering, a company that specializes in electronic design and manufacturing. "Mainly we do custom designs involving our digital voice recorder boards for clients around the world," he told me. "Our advertised products extend from my personal interest in amateur radio and a fascination with RDF."

Joe decided that a micro-T would be a good product to start his line of RDF gear. He realized that 25 milliwatts is fine for short range or high elevations, but most T-hunt scenarios demand more. "We built a few of the tiny Ts and had lots of fun, but they lacked the power we were looking for," he says. "Ken Bauer seemed to be a good choice to design a higher-power T for us and he agreed to do it."

By the time solder fumes cleared in the Agrelo lab, two models were ready to sell. Both are crystal-controlled with true FM modulation of the oscillator stage. Each includes an electret condenser microphone and high gain audio amplifier. There is a high-level (1 to 2 volts peak-to-peak) audio input also, to mate with your favorite "foxbox" tone generator.

At 1-1/2" x 9/16", the model VFC400 is only slightly larger than the 1993 "Homing In" project. With a 6-VDC supply, the unit I tested put out 190 milliwatts while drawing 140 milliamps. Four AA cells will power it for 20 transmitting hours. At the end of that time, the batteries will have sagged down to about half voltage, giving only 80 milliwatts output.

All hams seem to have inherited the "more power" gene, so it was natural for N2OOC and KB6TTS to

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in 1942. Ham radio got me into the Navy as a Radio Tech, and then as an Electronics Technician. And that got me plenty of adventure on a submarine during five war patrols. After college it got me my first job with radio station WEEB in North Carolina. Fellow RTTYers got me jobs later as the Secretary of the Music Research Foundation (where my classical music background helped), and working on a color organ Guggenheim Grant project for the Guggenheim Museum on Fifth Avenue.

It got me my first job in publishing as the editor of *CQ*. Most old-time hams have similar stories to tell.

So let's get out there and talk up our hobby and get the kids to think in terms of getting a ham ticket instead of the dead end of CB.

If you can't handle a talk show interview, at least see if you can get me connected. I can talk for hours. And hours. Did I tell you about the time I talked two hams into going on an African hunting safari with me? Robbie 5Z4ERR talked me into it on 20m. Wow, what an adventure that was!

If you've had some exciting ham adventures, why not grab your word processor and write? If I don't have enough room in *73* for all the stories I might make 'em into a book we can send to prospective hams to get their juices going.

"When you're running a ham club you are in show business."

How about the time I got 73 hams to go with me on a tour of Europe, with hamfests in London, Paris, Geneva, Rome and Berlin? Boy, did we have fun! We still talk about it when, at hamfests, I meet the hams who were on the trip with me.

And if you can't get on a talk show, at least get around to your local schools and talk to the fifth- and sixth-graders and get them excited.

Ham Club Woes

Between the ultra-bad band conditions of the last couple years, mainly the result of our not spending more for sunspots, and the continuing drop in the number of active hams, I'm seeing more and more anguished articles in club newsletters, hand-wringing over the club's disintegration. There are the usual complaints of no volunteers to help, fewer members coming to meetings, and so on.

My message is simple: Stop your bitching and breathe some life into your club. One fact of life is that very few club members ever have or will volunteer to do anything...unless you get them excited and involved. Most clubs are kept together by one to three spark plugs. It really only takes one to make a big difference.

Let me ask a direct question. How exciting are your club meetings? I've been to far too many clubs where the meetings are deadly bores. Where the president doesn't know any better than to allow business discussions to waste meeting time. If someone in the club has an unstoppable need to have business meetings, at least have them handled by a small "executive committee" and keep club business out of the regular club meetings. All you need is a short report from the executive committee on their actions.

I remember when the Nashua (NH) club spent an entire Friday evening discussing what color to paint the club building. That one bomb discouraged at least 10% of the members from coming again. It wasn't long before the club had no further need for their building and had to give it back to the city.

When you're running a ham club you are in show business. Meetings have to be fun or you'll lose your audience. Every meeting has to provide enough benefits to every member to get them to come back again. Otherwise you're up against Strange Luck, the X-Files or a movie. You have stiff competition, so you'd better put on a good show.

Benefits?

When's the last time you had a club member put on a slow-scan show and tell? Satellite communications? Packet? RTTY? Have you been giving your DXers an opportunity to show off their latest hot QSL cards? Certificate hunters their trophies? Have you invited a nearby ham dealer to tell you about some of the crazy things he's run into doing business with hams? Are there any ham manufacturers within driving distance?

You need interesting speakers. If you can't get them directly, maybe you can get them to do a video talk-to show to the club.

Speakers?

Here's the rules for speakers. If they're coming in from any distance you should offer to pay their transportation costs. Get three or four club members together for a dinner before the meeting. If your speaker has to fly in, meet him at the airport. Drive him to the hotel where you've reserved a room for him.

Whether the speaker is local or imported, make sure that he is the big deal at the meeting. I've given talks to scores of clubs and more than I like to remember had endless business meetings before it was time for me to talk. By then most of the members were just about asleep. Thanks, fellas.

If you're going to have elections, for heaven's sakes don't have a speaker that night too. That's happened to me at least a couple dozen times. Along about 10 p.m. I'm given the floor. By then I need a cherry bomb to wake 'em up.

The speaker comes before the coffee and doughnuts, too. Coffee is supposed to be a stimulant, but in my experience the only thing it stimulates at meetings is sleep.

If you find any outstanding speakers please drop me a note so I can pass the word along for other clubs. Alas, we don't have nearly enough good showmen among our manufacturers.

How About Me?

Probably not.

When I signed on as the editor of *CQ*, back in 1955, I was asked to speak at some hamfests. Whooee, did I have stage fright! When I got up to talk, my mind would go blank. A few hundred talks later I really enjoy giving talks and I almost never plan ahead. I just wing it, and generally keep everyone laughing. Well, look at all the really stupid things that we hams take seriously. Like the Honor Roll, the "need" to work a new DX station, the pompous foolishness Glenn Baxter airs endlessly, the garbage on 14,313, repeater jamming, the importance of the CW test to weed out the CBers, and so on.

The best ham raconteur by a wide margin is Jean Shepherd K2ORS/4, if you can coax him away from Florida. Try dangling $1,000 and trip expenses and see if that'll break him loose. He's worth every penny. All you have to do is get around 300 hams to pony up $10 each and then promote the heck out of the event.

"Our eating and drug habits are generating a wonderful $1 trillion business."

These days I don't have much time available to address hamfests or clubs. If I did have the time I'd like to get on the air more, and maybe visit a few more countries. There's still a bunch I haven't visited yet. But I've thinned down the *73* staff and am doing a lot more of the editing myself, which really eats up the time. Well, I wasn't happy with the way the magazine was going, so I decided to clean house a bit and run things myself for a while. I hope you'll begin to see some improvements. All this while the cold fusion field is really heating up. I've even had to turn down a speaking request in Russia. But just keeping up with the profusion of papers being generated in the cold fusion field is a serious time user.

Anyway, let me know what speakers you've had at your clubs that you recommend so I can pass on the word.

Tech Sessions

How about providing a half hour or so of theory before the regular meeting? There are few club members, young or old, who wouldn't benefit from this. Heck, you might even set up some code practice sessions before the regular meeting...one at 13 per and the other at 20 per. Teach 'em using my system. You can even talk to the group while they are copying, thus making sure they are copying automatically, and not trying to translate the dots and dashes.

Your Mercedes

If you've followed ol' Uncle Wayne's advice and started your own business, one of these days you'll be thinking of buying a Mercedes, Jaguar or Porsche. The Mercedes is a good investment because it's so well designed and built. The darned things often last for half a million miles, if you treat 'em right.

That means not using old crankcase oil for the engine, or tap water to refill the battery. It means not putting iron filings or sugar in the gas tank. It means cleaning and polishing it now and then. If you've ever seen a concours d' elegance contest, you've seen 20- and 30-year-old cars that look showroom-new.

Why should I make such ridiculous suggestions? You'd never treat a $50,000 or so car that way, right? So why would you care more about your car than your body, which is infinitely more complex and valuable to you? If you make enough money you can always replace even the most expensive of cars. But you get only one chance with your body. If you screw it up, there's no replacement, no matter how much money you make. Think about it. If you care to look at the instruction book for your body you will find big bold warnings against fueling it with Big Macs, fries and Coke. Worse, you not only are putting metal filings in your fuel system, you're encouraging your children and grandchildren to prematurely destroy their bodies too.

If you think I'm exaggerating, just take the time to go to a hamfest and take a good look around! These guys are busy reducing the expected life of their bodies from a vigorous 100 years to a sickly 50 or 60.

No, don't turn to your doctor for the instruction book. Up until a few years ago most doctors smoked, showing how little attention they've paid to the maintenance of their own bodies. Cigarettes were called "coffin nails" back in WWI, so there's never been any real secret about their destroying the body.

How many people in their 60s or 70s do you know who are in robust health? Well, the bright side of all this is that we're keeping the doctors and hospitals busy. Our eating and drug habits have generated a wonderful $1 trillion business and some

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great recent hospital TV programs.

We start right off by feeding our kids formula, thus partially crippling their immune systems for life. Then we zap them with so-called immunization shots, which further permanently screw up their systems. We fill their teeth with the deadly poison mercury, which then slowly leaches into their systems. And we take them to McDonalds and teach them to eat crap. We buy them sugar-frosted garbage for breakfast. Boo Berries?

"Fluoridation is doing everyone exposed to it serious harm."

There goes Wayne again? Hey. I've given you the references on all the above so you can do your homework. Please don't take my word for any of this. Do your own reading. I've read hundreds upon hundreds of books, and I've reviewed those for you that I've found the most authoritative. If you haven't kept track of my reviews, I've put them together in a booklet describing the books I think you are crazy if you don't read, together with the sources, if they are not likely to be available from your local library. No, I don't sell them through Uncle Wayne's Bookshelf. Oh, I considered it, but then I'd be accused of trying to make money with my recommendations. No, you're going to have to get these books on your own.

I mentioned my list during a recent radio talk show interview and got over a thousand requests for it. Then came the follow-up letters thanking me for doing all that research, and telling me how wonderful the books are I've recommended. You can have my list for $3 plus a 6x9 envelope with a 32¢ stamp on it. If you don't have an envelope, then make it $4 and I'll address it to you and put on the postage. Send cash or check to Uncle Wayne, 70 N202, Peterborough NH 03458-1107. If you order at least $10 worth of stuff you can use a credit card, and even call in your order. Like a subscription to *73*, for instance, or a couple more of my booklets, or even my *Declare War* book.

If you ruin your Mercedes you can always buy a new one. If you ruin your body, you'll have to reincarnate to get a new one. Think about that the next time you buy a six-pack.

Death By Government

The more I read about the things our government is doing to us, the more discouraged I get. Not just that it's happening, but that we, the people, let it happen in the first place, and then, even after we find out about what's happened, we don't made any serious effort to stop it. I've written about how our government is allowing our dentists to continue to put dental amalgam in our mouths, and our children's, even though it's 50% mercury, which is acknowledged to be a deadly poison, which is causing terrible health problems for millions of people. I've written about vaccinations and the trail of death and sickness they're leaving, with there not being one shred of scientific proof that they work.

When I was a lot younger I remember the fight a few extremists put up against our city governments fluoridating our water. Bunch of kooks, we were told by the media. Well, I know you're not going to believe this, but it turns out the kooks were right, for a change. There are any number of scientific studies which show that (a) fluoridating us does not help fight tooth decay, and (b) the fluoridation is doing everyone exposed to it serious harm.

Sure, only a small percentage of the children who get their teeth swabbed with a fluoride solution by dentists or their dental assistants die from it. I suppose that's an acceptable loss, as long as it isn't your child. And it's not enough so the doctors can't cover it up to avoid lawsuits.

In areas where the water has been fluoridated the cancer rate has increased substantially. In high fluoride areas the people age prematurely, their teeth drop out, and their bones get very brittle. Even minor shocks can cause a hip fracture, which in an elderly person is virtually a death sentence.

How about the three-year-old child who had his teeth swabbed at a clinic? The nurse gave him a glass of water to rinse out his mouth and turned away to gossip with someone. The child drank the water and was dead in a few hours.

There goes Wayne with his hyperbole of gloom and doom, right? Hey, don't believe me. But do get a copy of *Fluoride, The Aging Factor*, by Dr. Yiamouyiannis, Health Action Press, ISBN 0-913571-03-2, 292p, $15, and do your own homework. He's got all the research data there for you. I'm not exaggerating. I'm understating the situation. Yes, your government is, in many cities, pouring this poison into your water supply. And this poison is not only causing a wide range of illnesses, it is also causing chromosomal damage which is then passed on to the next generation. Cities and towns are adding from 0.6 ppm to as high as 8.0 ppm of fluoride to your water.

How do you get away from it? A home still helps. I've been drinking distilled water for some time now, and am getting my own still. How about Coke? The stuff is packed with fluoride (2.56 ppm). So is Diet Coke (2.96 ppm, and it only takes 0.5 ppm to cause serious trouble). And it has aspartame, to further derail your body's ability to cope with life.

Freedom

For a country that prides itself on and preaches freedom, we have an awful lot of tyranny going on. I think I can even make a good case for liberals being disciples of the Devil. All those things that our beloved government legislates "for our own good" are my beef.

Like what? Like vaccinations, fluorides in our water supply, seat belt laws, helmet laws, and so on. I've written about vaccinations, which besides not working, are causing life-long health problems for many people. Ditto fluorides in our water. I wish that Congress and the state legislatures would stop using the law to do things for my good. All I need is the information and then the freedom to make my own decisions.

Sure, seat belts save lives, but if I'm dumb enough to not use them, then that should be *my* decision. Mother Nature (aka God) has a system that has worked for millions of years. Billions. It's called natural selection, or the survival of the fittest. So if I'm dumb enough to not wear a helmet on my scooter or a seat belt, if I get killed that will tend to weed out that kind of dumbness. By forcing me to live longer and thus be able to have more children, the government is going against God and weakening the human race.

How about so-called Social Security? It was originally set up as a way for the government to take in more money, pretending it was insurance instead of increased taxes. It's still taking in billions more than it's spending and Congress is "borrowing" the surplus and spending it. If it was a voluntary system I'd have no complaint. But it's mandatory, and that's not my idea of freedom. Sure, it's "for my own good." If I'm dumb enough not to provide for my old age, the government will support me. The result of that is that a lot of people don't provide for their old age in some other much cheaper way.

Water, Water, Everywhere!

And not a drop to drink. Well, not a drop that's safe to drink, anyway.

I've written about how we're slowly poisoning ourselves in various ways, all complete with references so you can completely disbelieve what I'm reporting and go to my sources. All I can do is lead you to the fountains of information. I can't force you to read. But at least, for those of you who have any interest in living long and in good health, I'm pointing out the path. Of course, if you prefer to smoke, eat crap, and couch-potato away your life, that's your choice.

Now, about water. My thanks to Emory Schley N4NCU, who dropped me a postcard suggesting I call Acres USA and get a copy of *The Choice Is Clear*, by Dr. Allen Banik. It's a 40p $2.50 book and worth a million bucks. Or whatever you feel your health is worth. Maybe 2¢ is closer, judging from the constipated 13-month pregnant potbellies I see walking around at hamfests. What a terrible thing to do to a perfectly good body! Heck, even when I was fat I never did *that* to myself.

Anyway, invective and insults aside. I got the book and loved it. I'd already read an excellent book on how the fluorides added to most public drinking water are causing serious illnesses. And I've seen references to the damage that the chlorine in our water is doing to us. But I thought that, heck, since I live on a farm with my own well, I was safe. Once I read the bad news in this book I sighed and started buying distilled water to drink.

You'll read about Dr. Bragg, who at 94 had the blood pressure of a 20-year-old. I seriously doubt you'll read this short book and not change to distilled water. The Dr. Banik book is available from Acres USA, Box 8800, Metairie LA 70011.

I've been lacing my distilled water with some of Pat Flannagan's Crystal Energy. But that's another story, and a fascinating one. I'll go into the details for you, complete with where you can get some of his magic elixir.

My water bill is mounting and I'm up to here in gallon water bottles, so I've got to shop around and see where I can get a still and make my own water.

The more research I do, the more I'm convinced that if we'd eat right, drink pure water, avoid EMFs, get rid of dental amalgam, avoid immunizations, and breathe clean air (such as we have in abundance in New Hampshire), we'd have a good shot at getting a mention by Willard Scott on the "Today Show." Of course, if you prefer that you and your family be crippled by arthritis, Parkinson's, cancer, diabetes, high blood pressure and so on, that's your choice. My dad chose to smoke despite anything I could say, so he had to spend the last 10 years of his life with an oxygen bottle at his side because he only had 5% of his lungs left working. Imagine not being able to really breathe for 10 years! He smoked Camels. Didn't the Marlboro Man die of cancer? Or was it emphysema? My grandfather, who smoked cigars, died in his 50s as a result. So did my uncle. And, unless the medical establishment puts out a contract on me for spoiling their business, I intend to keep writing my editorials for another 30 years. Or so. 73

Making Your Club More Exciting

How the BARA broke out of its rut.

Dee Interdonato NB2F
118 Westervelt Place
Lodi NJ 07644

Sometimes clubs stagnate with business meetings; the more active and creative members become discouraged, and stop attending meetings.

A few years ago, The Bergen Amateur Radio Association (BARA) was in just such a rut. We got to brainstorming as to how we might give our membership some fun, as well as show our local community commitment, *and* get some public exposure for amateur radio. With our 30th anniversary approaching, we wanted to cook up something special.

Since it was also the 300th anniversary of Hackensack and the 50th anniversary of the *Ling* submarine, where we'd successfully celebrated our 25th anniversary, we agreed on setting up another special events station on the *Ling*.

The plans for the special event kept us busy for the next few meetings, with excitement building among the club members. One member, Mike Surmick WA2QWM, was employed by the City of Hackensack (located in northeastern New Jersey), so he became our liaison with the city. In fact, he became the unofficial leader of our event and we used his call for the special events station.

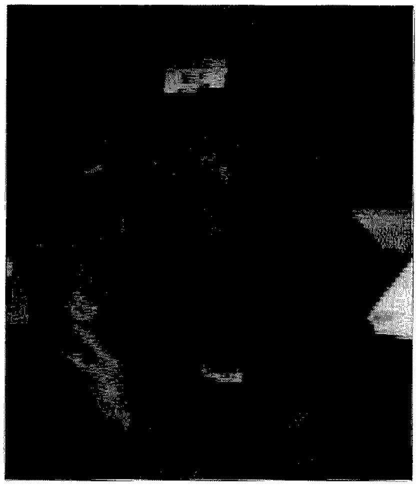


***Photo A.** L/R Vince N2AXV, John KC2EV, Mike WA2QWM, Dave N2IMC at the packet station.*

***Photo B.** Dee Interdonato NB2F (the author) operating in the* Ling *radio room.*

We contacted the *Ling* and informed them of our intentions. After our 25th anniversary there, they knew us well and enjoyed the publicity as well as the added revenue from visitors. Now all that had to be done was planning for the special event station equipment and operators, the food, and as much publicity as we could generate.

The setup began in the morning and operation started that evening. Bob Wilson N2RLI volunteered his RV full of ham gear, and our Field Day antennas were ready to go. WA2QWM, our special event station on board the *Ling* was on the air!

After many hours of operation, hundreds of QSOs on HF, VHF, UHF, packet, and satellites, after numerous demonstrations and handouts about amateur radio were given to the public, after vast amounts of food were consumed, and the cleanup was over, the certificate committee went to work. Chaired by John Chooljian K2KRF (a WWII radioman on an LST in the Pacific), the committee had the job of filling out and sending the certificates we had offered. Though the HF bands were not cooperating for DX contacts, many were made via our ham satellites, so we had plenty of foreign requests for certificates.

Since we had so many modes of operation, our club members had an opportunity to become exposed to them; it was a fine training event for us too! Although I am a satellite operator at heart, after the event I soon became active in packet.

The club members were given tours of the *Ling* and told some fabulous stories of submarine life and the history of the *USS Ling*, making this one of our club's finest events. Obviously, all ham clubs don't have access to a submarine for a special event, but if you look around you might find an old steam locomotive, a historic building, an airfield, etc. But the location of the event isn't the most important thing. It's getting your club involved that will keep interest in your club high, and help promote our hobby with the public. We helped a submarine association and maybe you will help another historical society, a hospital, or a library. With Congress cutting back on pork, keeping important places, things, and moments in history alive will help promote amateur radio and provide a good public service. 73

HOMING IN

Continued from page 79

attempt to squeeze out even more RF. This resulted in the model HPVFC, with a beefier final stage transistor. The HP stands for high power, of course. Final stage gain is the same, so I measured the same power output at 6 VDC as the VFC400 produced. However, the HPVFC can safely operate from a 9-volt source, which produced 300 milliwatts for me.

No Microscope Required

Photo A shows an HPVFC as it comes from the shipping box. It's about a half-inch longer than the VFC400. The Agrelo micro-rigs aren't kits, but they aren't plug-and-play either. All the hard work of mounting the dozens of tiny SMT parts has been done and the assembly has been tested and tuned. You must provide your own enclosure and solder in the wiring and connectors of your choice for antenna, power, and audio. Be careful, as there is no protection from damage due to reversed power polarity.

An important thing to consider in evaluating a fox transmitter is how it behaves as the battery becomes drained. If you do a good job of hiding your T, the hunt will take awhile and you might not be near your transmitter when the battery begins to poop out. Some other rigs I have encountered go far off frequency (maybe out of band!) or develop an audio howl as the input voltage is cut in half. They are completely unsuitable for use in an unattended station.

The Agrelo Ts that I tested scored well in this regard. The HPVFC audio remained clean as voltage was reduced to 1.8 volts. Below that, the oscillator shut off. Carrier frequency shift from 3 to 9 volts was 2 kHz. (Unfortunately, no frequency adjustment trimmer is provided.)

Even a QRP hidden transmitter has to be spectrally pure, because it may get hidden near an airport or other sensitive location. Remember, the second harmonics of a 2 meter signal are on frequencies used by aircraft! Hiders in Southern California like to put Ts on top of mile-high mountain peaks, where a few milliwatts can cover thousands of square miles.

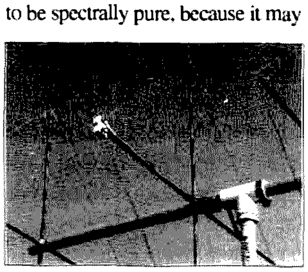


Photo C. The Yellowjacket quad is fed directly from RG-8X coax. About five turns of coax around the boom provide decoupling and matching.

There are some other transmitters being sold to T-hunters that have not been reviewed by "Homing In" because I have found them to be spectrally "dirty." Output filters aren't difficult to include in base and mobile transceivers, but when you're trying to make a postage-stamp-sized rig, it becomes much more tricky. Rather than ignore the problem and pass it off by saying "It's a kit," Agrelo Electronics bit the bullet and figured out how to include a tiny two-stage low-pass filter in the HPVFC. My spectrum analyzer check of the HPVFC found that all harmonics and spurs above the carrier frequency were down -52 dB or better, easily surpassing the FCC requirement of -40 dBc for low-power VHF transmitters.

For its small size, the HPVFC is amazingly rugged. However, the unit I tested did not have heat sinking on the final stage. With a 9-VDC supply, the output transistor got quite hot and power output dropped 20 percent in less than a minute. Besides the power decrease, high-temperature operation can dramatically shorten final transistor life.

For low-duty intermittent signal hunts (less than 10-second transmissions and at least a minute between transmissions), temperature should not be a problem. Otherwise, I recommend adding some heat sinking to the final stage for operation above 6 volts. For instance, you could cement the flat surface of a 1/2" x 3/8" finned sink to the trimmer side of the board, behind the final transistor. The layer of cement must be very thin for good heat transfer. After installing your sink, use a regulated power supply and check power output versus time for your planned transmission timing. If power output drops more than 10 percent, you need more heat sinking.

Two frequencies are available from stock: 146.565 MHz and 145.79 MHz. 146.565 has become the de facto national simplex T-hunting frequency, recognized by coordinators in Southern California and elsewhere. 145.79 is used in much of the USA for Automatic Packet Reporting System (APRS), as described in several previous "Homing In" articles. APRS enthusiasts are discovering that HPVFC is a good choice for use in miniature stand-alone trackers. Agrelo Engineering will crystal your HPVFC on another 2 meter frequency of your choice for an additional $30.

New Quad for T-Hunting

For a simple, inexpensive and effective mobile T-hunting antenna for 2 meters, it's hard to beat a yagi or cubical quad. Just rotate the mast carefully to peak up the incoming signal on your receiver's S-meter, and the front of the antenna will be aimed in the signal source direction.

A four-element 2 meter quad certainly does not result in a "stealthy" RDF system. Nevertheless, it is the antenna of choice for Southern California mobile T-hunters because its high gain makes it possible to track signals at greater range. Once you figure out how to support and turn the mast in the passenger-side window frame and armrest, you can be ready to go T-hunting in a couple of hours.

It's easy to make a lightweight RDF quad for your favorite VHF or UHF band using ordinary PVC plastic plumbing supplies from your local hardware store. However, lots of hams have asked me how to buy one ready-made. Ed Buchanan KN6CL of the Fullerton Radio Club saw this as a business opportunity.

Ed says he's a pipe fitter by trade, but he has always liked to build antennas, particularly quads. That's what led him to buy the Cubex Antenna Company from Karl Scharping W6KWF about a year ago. "Cubex has been in business for 39 years," Ed says. "I bought an antenna from Karl in 1992 and at that time I asked him if he planned to sell his business. He was in his mid-80s, but he said he had never thought about it. But he called me a few months later and said he was considering retirement. We got together and struck up a deal."

Cubex is best known for ruggedly-constructed "monster quads" for DXers. W6KWF had never sold antennas for bands above 30 MHz. KN6CL decided that for Cubex to grow, it should add T-hunters and other VHF enthusiasts to the customer base.

The new Cubex Yellowjacket four-element 2 meter quad (Photo B) is quite similar to the strung-wire quad in my T-hunt book (see the sidebar),

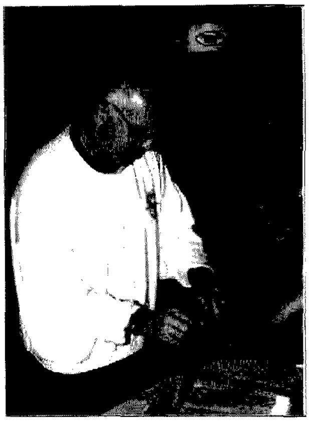


Photo D. At the factory in Brea ,CA, technician Ed Hocking AB6N (left) puts another ready-to-ship 2 meter quad kit into its bag with help from new Cubex owner Ed Buchanan KN6CL.

but Ed made some changes that make it more rugged. The boom is 1" O. D. tubular Fiberglas and the spreaders are quarter-inch-diameter solid Fiberglas rod. Elements are solid tinned copper wire. "I pre-stretch the wire when I make them so they are not going to sag," Ed says. All hardware is stainless steel.

For quickly changing wave polarization to match the signal (horizontal, vertical, or anything in between), the PVC boom-to-mast tee allows the boom to be rotated (Photo C). A worm-gear clamp adjusts the tension on this joint. You can slide the coupler as required to optimize mechanical balance.

Like Cubex HF quads, the Yellowjacket is shipped in kit form (Photo D). Color-coded tapes on the boom, spreaders, and elements make assembly quick and simple. You must provide the mast and coax. RG-8X is recommended for minimum loss and easy rotation.

The driven element is directly fed without a matching network. A coil of coax around the boom ahead of the driven element provides matching and decoupling. Adding turns to this coil moves the resonance point slightly higher in frequency. I found that five turns gave a near perfect match on 146.565 MHz.

I did far-field comparison tests of the Yellowjacket against my venerable stiff-wire quad, which I have used since I started T-hunting. This antenna (pictured on the cover of the T-hunt book) has nearly the same boom length and element spacing as the Yellowjacket, so I expected gain and

pattern to be quite similar. They were. Front-to-back, front-to-side ratios and 3 dB beamwidth were nearly identical. The forward lobe peak was squarely on axis.

The Yellowjacket had about 2 dB greater forward gain than my reference quad. Since gain and front lobe beamwidth are directly related (as explained on page 39 of the T-hunt book) and since both quads had nearly the same measured beamwidth, this was a surprise. Could it be that the oxidized wire on my old antenna has more loss due to "skin effect" than the shiny tinned element wire on the Yellowjacket? Guess it's time to retire the old quad!

I expected the thick-wall Fiberglas boom on the Cubex quad to make it noticeably heavier and harder to handle than the stiff-wire quad, but this was not the case. Of course, no mobile quad is completely safe from low-hanging tree branches, but this one should do quite well.

Now that Cubex has done the hardest part of making an RDF antenna for you, you should have no excuse for missing the fun of your club's next 2 meter RDF contest. See you on the hunt! 73

Product Information

Agrelo Engineering
1145 Catalyn Street
Schenectady NY 12303
Phone (518) 381-1057
FAX (518) 381-1058
E-mail jagrelo@aol.com
Web http://home.navisoft.com/agrelo/ae.htm

VFC400 transmitter $99.95. HPVFC transmitter $129.95. Add $5 shipping/handling. New York state residents add sales tax.

Cubex Antenna Company
2761 Saturn Street Unit E
Brea CA 92621
Phone (714) 577-9009
FAX (714) 577-9124

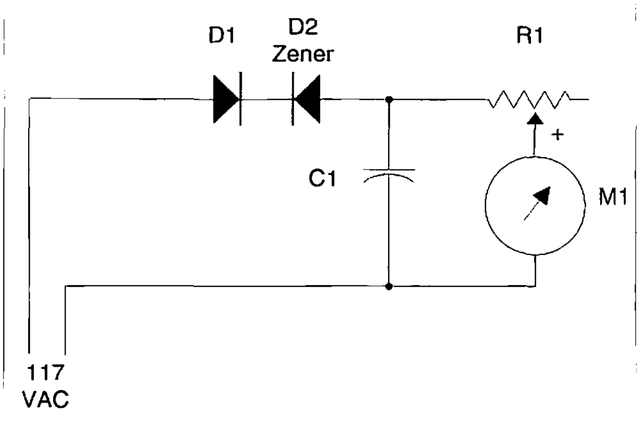
Yellowjacket 2 meter four-element quad $44.95 plus $6 shipping/handling. California residents add sales tax.

Construction plans and installation ideas for mobile strung-wire and stiff-wire VHF quads are in *Transmitter Hunting—Radio Direction Finding Simplified* by Joe Moell KØOV and Tom Curlee WB6UZZ. This 323-page reference book (TAB/McGraw-Hill #2701) covers all aspects of RDF and is available from Uncle Wayne's Bookshelf. #TAB2701 $19.95

UPDATES

In the January 1996 issue of *73*, we ran "Line Voltage Monitor" by J. Frank Brumbaugh KB4ZGC, beginning on page 86, without including Fig. 1, the circuit.

Here it is:



Number 85 on your Feedback card

HAM HELP

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full 8 1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

If you are interested in amateur radio, and helicopter aviation, and would like to contact others with the same interests, there is a non-profit organization called "World Heli-Hams" that might be able to help. If interested, contact *Mr. Marden Pride, 34 Fountain St. A5, Haverhill MA 01830 USA. E-Mail: wb1ggi@gw.w1mx.ampr.org. Packet: WB1GGI @ K1UGM.#EMA.MA.USA.NOAM.*

Needed: Manuals for (1) IBM Portable PC Mod 5155; (2) CITIZEN 120D Dot Matrix Printer. *Peter A. Bergman NØBLX, 3517 Estate Dr. SW, Brainerd MN 56401. Tel. (218) 829-6286.*

Needed: Copy of alignment section of manual for HEATHKIT GR.78. I will pay for photocopies and postage. *Sam Cogar, P.O. Box 755, Houghton Lake MI 48629.*

Wanted: Manual and/or Schematics for the HEATHKIT SB-10 Single Sideband Adapter. *Roy Austin VE6RRA, Box 1388, Claresholm, AB Canada TØL ØTØ. Tel. (403) 625-4379. Compuserve 102215,1747.* 73

UNITED STATES POSTAL SERVICE STATEMENT OF OWNERSHIP, MANAGEMENT AND CIRCULATION [illegible]

ASK KABOOM

Continued from page 78

I just assume the transistor is bad. Luckily, they nearly always fall open, not shorted, so there's usually no other damage to the horizontal circuitry. Replacing the transistor is as easy as simply soldering in a new one. Be sure to use heat-sink goo if there was some on the old part. By the way, you can get these transistors at most parts houses and TV shops. Even Radio Shack sells them. Expect to pay between about three and seven dollars. Unlike with many other parts, you don't need an exact cross-referenced replacement. They're all NPN, and just about any horizontal output transistor will work in the average-sized monitor. But please don't even consider putting in any kind of transistor other than one made for horizontal output service; it won't work and probably will blow faster than you can hit the "off" switch, possibly doing further damage to the monitor!

Try It

Check the fuses in the power supply. If there's a bad one, change it. Now, give it a try! If you're lucky, your monitor will come to life. If you have a computer connected, you should get a picture. With no computer connected, the screen may remain completely dark, but you should hear that lovely high-voltage crackle, and touching the front of the screen should give you some static electricity. That means the horizontal and high voltage are working, and, most likely, so is the whole set. If it does work, take a look at the back of the picture tube to be sure the filaments are on. They should glow a dull orange.

Nada

If it still doesn't work, your task is not yet complete. Next time, we'll continue this topic, looking toward the power supply. Until then, 73 from KB1UM. 73

If time and/or money were not a factor, what ham equipment would you prefer? What would you do hamming-wise differently than you do now? Write: 73 Wish List, 70 R 202 N. Peterborough NH 03458

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the April 1996 classified ad section is February 12, 1996.

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd. USA. Send to: **ALLABOUT BOOKS.** Dept. S. P.O. Box 22366, San Diego CA 92192. BNB200

NOW ON 40 METERS! NEW. KNOB-TUNED w/DIGITAL DISPLAY. SYNTHESIZED QRP transceiver. Complete kit only $199.95. S&H $7.50 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING,** 14102 Brown Road, Smithsburg MD 21783; (301)416-0661. BNB334

RCI-2950/2970: New modification manual including Power increase. Clarifier modification. Modulation increase. Operating hints, and more. Parts included. Only $20.00 ppd. in U.S. (Missouri residents add $1.15 tax). **SCOTT.** P.O. Box 510408, St. Louis MO 63151-0408. (314)846-0252. Money Orders or C.O.D. BNB340

NI-CD BATTERY analyzer cycler. PC controlled. DOS software. $289 PO Box 672, London, Ontario Canada N6A 4Y4 **Lamantia Products** 519-472-5566 Fax 519-472-1702 BNB385

IT'S BACK! The return of the HW-8 Handbook! Second print ing. Modifications for the Heath QRP rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce, WB8VGE.** 2225 Mayflower NW, Massillon OH 44647. BNB404

HEATHKIT WANTED! S.B. Series **'Green Front'** for parts. **Robert Schlegel** 2302 286th St. East, Roy WA 98580 BNB910

MAHLON LOOMIS, INVENTOR OF RADIO: by Thomas Appleby. (Copyright 1967). Second printing available from **JOHAN K.V. SVANHOLM, N3RF, SVANHOLM RESEARCH LABORATORIES,** P.O. Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H BNB420

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SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $12. **LEARN MORSE CODE IN 1 HOUR.** Amazing supereasy technique $12. Both $20. Money back guarantee. Free catalog: SASE. Bahr-T2, 150 Greenfield, Bloomingdale, IL 60108. BNB1025

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WANTED: HAM EQUIPMENT AND RELATED ITEMS. Donate your excess gear, new-old-in-any-condition to the Radio Club of Junior High School 22, the Nation's only full-time, nonprofit organization working to get Ham Radio into schools around the country as a teaching tool using our EDUCOM—Education Thru Communication— program. Send your radio to school. Your donated material will be picked up ANYWHERE or shipping arranged, and this means a tax deduction to the full extent of the law for you as we are an IRS 501(c)(3) charity in our 15th year of service. It is always easier to donate and usually more financially rewarding, BUT MOST IMPORTANT your gift will mean a whole new world of educational opportunity for children nationwide. Radio's you can write off, kids you can't. Make 1996 the year to help a child and yourself. Write, phone or Fax the **WB2JKJ "22 Crew"** today: The RC of JHS 22, POB 1052, New York, NY 10002, 24 hours call 516-674-4072 or Fax 516-674-9600. Join us on the WB2JKJ CLASSROOM NET, 7.238 MHz 1200-1330 UTC daily, and 21.395 MHz from 1400 to 2000 UTC. Meet us at the upcoming Charlotte Hamfest. BNB762

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PRINTED CIRCUIT BOARDS for projects in *73*, *Ham Radio*, *QST*, ARRL Handbook. List SASE. **FAR CIRCUITS,** 18N640 Field Ct., Dundee IL 60118. BNB966

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SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

FEB 3

AMARILLO, TX The 1st Annual Amarillo ARES/RACES Hamfest and Severe Weather Emergency Comm. Expo will be held at the Texas Army Nat'l. Guard Armory, 2904 Tee Anchor Blvd. Events include NWS Skywarn Spotters School, APRS demo, ATV demo, VE Exams, 3933 Net Meeting, Flea Market, and more. Sponsored by Potter County ARES, and Amarillo, Potter, Randall RACES. Call *Ben Pollard WS5R at (806) 381-8810;* or write *ARES, P.O. Box 5378, Amarillo TX 79117.*

FEB 10

NORTH CHARLESTON, SC The 23rd Annual Charleston Hamfest and Computer Show will be held 8:30 AM–4 PM at Stall H.S. Talk-in on 146.79, the WA4USN Linked Rptr. System aboard the USS Yorktown, and the 145.25 Rptr. near Summerville. Walk-in VE Exams will be given on site. Bring original and copy of your license, any CSCEs you have, and two IDs, one with a photo. Exams begin at 12 noon. For Exam info, call *Ed KC4OOZ at (803) 871-4368,* or *Gary AC4PL at (803) 766-3440.* For Hamfest info, contact *Jenny Myers WA4NGV, 2630 Dellwood Ave., Charleston SC 29405-6814. Tel. (803) 747-2324.*

FEB 11

LATROBE, PA The Chestnut Ridge ARC's 2nd Annual Latrobe Winterfest Hamfest and Computer Show will be held 8 AM–3 PM at Latrobe American Legion, 1811 Ligonier St. Talk-in on 145.150 (-600). For reservations and info, contact *Chris Weiss K3JDU, (412) 537-6068; Carol Demosky N3UVA, (412) 539-1552;* or *Cliff Britt N3NBE* (via Packet) *N3NBE @KA3JSD.SWPA.WPA.PA.* Please send all payments to *C.R.A.R.C., PO. Box 175, Loyalhanna PA. 15661-0175.*

MANSFIELD, OH The Mansfield Mid-Winter Hamfest/Computer Show will be held at the Richland County Fairgrounds in Mansfield, starting at 7 AM. Talk-in on W8WE 146.34/.94. Contact *Pat Ackerman N8YOB, 63 N. Illinois Ave., Mansfield OH 44905;* or phone *(419) 589-7133 after 6 PM EST.* Sponsor: InterCity ARC.

FEB 16–18

ORLANDO, FL The ARRL State Convention and 50th Anniversary Orlando HamCation Show and Computer Show will be held Fri. 5 PM–9 PM; Sat. 9 AM–5 PM; Sun. 9 AM–4 PM at Central Florida Fairgrounds on Rt 50. Forums by ARRL and NASA. 3 DX Presentations, MARS, and Ladies Programs. Talk-in on 146.760. For info and advance tickets, contact *Orlando HamCation, P.O. Box 547811, Orlando FL 32854;* or *Ken Christenson, (407) 291-2465; or E-Mail KD4JQR@aolcom.com.*

FEB 17

ROSEVILLE, MI The L'Anse Creuse ARC will hold an amateur radio Open House at the Macomb Mall, for the purpose of introducing ham radio to the public. They will operate KB8YUV 1500 UTC–2100 UTC and will invite visitors to join them on the air. Operation will be phone and CW in the General portion of the 80 through 10 meter bands. Contact *Dave Herrington N8NLK, (810) 465-2797;* or by e-mail at *dharring@macomb.lib.mi.us.*

SALEM, OR The Salem Rptr. Assoc. and Oregon Coast Emergency Rptr., Inc. will co-sponsor the 1996 Salem HamFair at the Polk County Fairgrounds in Rickreal OR, 9 AM–4 PM. Swap table setup 6 PM–9 PM Fri. night, and 7 AM Sat. morning. Talk-in on the 146.86 Rptr. Flea Market, Dealers, and Exhibits. Contact *Evan Burroughs N7IFJ, (503) 585-5924.*

TRAVERSE CITY, MI The Cherryland ARC will host their 23rd Annual Swap-n-Shop at Immaculate Conception M.S., 8 AM–Noon. VE Exams following the Swap. Talk-In on 146.86. Contact *Joe W8TVT* at *(616) 947-8555;* or *Chuck W8SGR at (616) 946-5312.*

FEB 18

DAVENPORT, IA The 25th Annual Davenport ARC Hamfest will be held 7:30 AM–3:30 PM at the QCCA Expo Center, 2621 4th Ave., Rock Island IL. Talk-in on the WØBXR 146.28/.88 Rptr. For info, tickets, reservations, SASE to *Kent Williams K9UQL, 4245 10th St., East Moline IL 61244-4154.* For VE Exams, SASE to *Roger Franke K9AYK, 2506 E. 29th Court, Davenport IA 52803.*

FEB 24–25

CINCINNATI, OH The ARRL Great Lakes Div. Convention 1996 will be held at Cincinnati Gardens Exhibition Center, 2250 Seymour Ave., Langdon Farm Rd., 8:20 AM–5 PM Sat. and Sun. All indoors. VE Exams. Flea Market. Accomodations at the Quality Hotel, Central, Norwood OH, (513) 351-6000. For info contact *Stan Cohen WD8QDQ, Chairman, 2301 Royal Oak Ct., Cincinnati OH 45237. Tel. (513) 531-1011.*

FEB 25

CUYAHOGA FALLS, OH The Cuyahoga Falls ARC, Inc. will sponsor their 42nd Annual Hamfest Computer Show/Flea Market at Emidio & Sons, 48 Bath Rd. Tables must be reserved in advance. For details, call *Carl N8JLQ, (216) 497-7047.*

LIVONIA, MI The Livonia ARC will present its 26th Annual Swap 'n Shop 8 AM–3 PM at the Dearborn Civic Center, Dearborn MI. ARRL/VE Exams. Talk-in on 144.75/5.35. For info, send 4" x 9" SASE *c/o Neil Coffin WA8GWL, Livonia ARC, P.O. Box 2111, Livonia MI 48151. Tel. (313) 261-5486.*

NEW WESTMINSTER, BC, CANADA The Burnaby ARC will host their Annual Flea Market at Westminster Armouries, 6th St. at Queens. Setup at 0900; buyers from 1000–1400. Talk-in on VE7RBY, 145.35 or 442.85. Please contact the club net Monday nights at 2000 local time on 145.35; or write the club at *Box 72012, 4429 Kingsway, Burnaby BC V5H 4P9, Canada.*

PITTSBURGH, PA AN ARRL-Sanctioned Hamfest and Computer Show, sponsored by the South Hills ARC, will be held 8 AM–3 PM at Castle Shannon VFD Memorial Hall, Route 88 (Library Rd.), Castle Shannon PA. Talk-in on 146.955(-) and 146.46 simplex. For tickets and reservations contact *Hamfest Chairman: Steve Lane N3RNY, P.O. Box 11626, Pittsburgh PA 15228. Tel. (412) 341-1043.*

MAR 2

ABSECON, NJ The Shore Points ARC will sponsor its 14th annual hamfest, "Springfest '96," at Holy Spirit H.S. on Route 9 (3/4 mi. south of Route 30), starting at 9 AM. Setup at 7 AM. Flea Market. Talk-in on 146.385/.985. For info, write to *SPARC, P.O. Box 142, Absecon NJ 08201.*

MAR 3

BRAINTREE, MA A Ham Radio Flea Market will be sponsored by the South Shore ARC 9:30 AM–2 PM at DAV #29 Hall on Liberty St. Set-up at 8 AM. No tailgating in the parking lot! Talk-In on 146.67(-) Quincy Rptr. VE Exams for pre-reg. participants. Parking in Parking Lot only (no side streets or yards). Contact *William Morgan, 25 Helena Rd., Boston MA 02122.*

SPECIAL EVENT STATIONS

FEB 11

SEATTLE, WA The 3rd Annual NW QRP Club Winter Sprint will be held 1800 UTC–2259 UTC. Freq.: CW—3560-3580, 7035–7040, 14060, 21060 kHz. SSB—14285, 21385, 28385 kHz. Send completed logs by Feb. 29th, 1996 to *Stan Yarema KG7ME, Contest Editor, 3457 12th West, Seattle WA 98119.*

FEB 17–18

ALEXANDRIA, VA The Mount Vernon ARC will operate N4BV 1600Z–2200Z Feb. 17th–18th, to commemorate George Washington's Birthday. Operation will be in the lower General 80–15 meter phone subbands, and in the Novice 10 meter subband. For a certificate, send QSL and a 9" x 12" SASE to *MVARC, P.O. Box 7234, Alexandria VA 22307.*

Number 88 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Old Sol is staging a surprise for all of us! The first spots of solar cycle 23 have appeared about 30 degrees north (and south) of the sun's equator, along with old spots of Cycle 22 near the equator. The polarities of Cycle 23 spots are the opposite of those of Cycle 22 spots. It looks as if Cycle 22 will be—or has been—shorter than normal (about 9.5 to 10 years instead of 10.5 to 11.5 years), as I suggested more than a year ago.

In fact, it is possible that the sun spot minimum may occur as early as June this year, accompanied by rapidly increasing solar flux levels not long thereafter. The "up" side plot of solar flux values for any cycle is usually steeper than the "down" side plot, so rejoice!

10-12 Meters

February is shaping up as a very good month for DXers, I think. The *best* days (G) are Feb. 1 to Feb. 4, and Feb. 12 to Feb. 21. The *worst* days (P) are likely to be Feb. 7 and Feb. 8, and Feb. 24 to

FEBRUARY 1996

SUN	MON	TUE	WED	THU	FRI	SAT
				1 G	2 G	3 G
4 G	5 F	6 F-P	7 P	8 P	9 P-F	10 F
11 F-G	12 G	13 G	14 G	15 G	16 G	17 G
18 G	19 G	20 G	21 G	22 G-F	23 F-P	24 P
25 P	26 P	27 P	28 P	29 P		

29. Yes, that's right, this is leap year, and February has 29 days. On Good days, the higher bands will be open longer and signal strengths better than last month, as we approach the Spring equinox, and you may find some surprising and welcome activity on 10 and 12 meters.

15-17 Meters

The 17-meter band has been quite good all through 1995, with some excellent openings—at times very much like 20 meters. I expect this will improve in 1996, and you may see 15 meters come alive, too.

20-160 Meters

Twenty meters, as always, will be your dependable DX band, while 30 and 40 continue their excellent winter ways, as do 80 and 160, but these latter two bands will soon begin to show signs of Spring with (QRN) and a poorer Signal-to-Noise ratio. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15[1]	15[1]
CANAL ZONE	15	20	20	40	40		20	20	15	15	15*	15*
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15[1]	15[1]
INDIA						20[1]	40[1]	20[1]				15[1]
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15*	15*
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15*	15*
SOUTH AFRICA			40[1]	40[1]				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80*	40*	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15[1]	20[1]	20[1]				40[1]	20[1]	20[1]			
JAPAN						80*	40*	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40*							15	15	20	20
U.S.S.R	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80*	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80*	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40[1]	40[1]							15	15	20
U.S.S.R.		40[1]	40[1]	40[1]	40[1]				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

1Check next higher band
*Bp-Meters possible on good days only

MARCH 1996
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73 Amateur Radio Today

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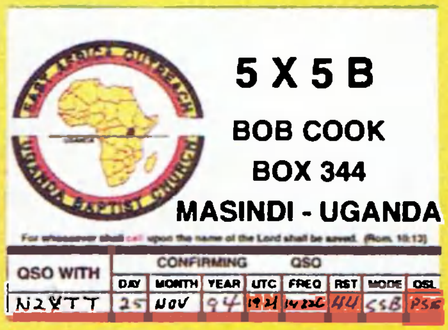
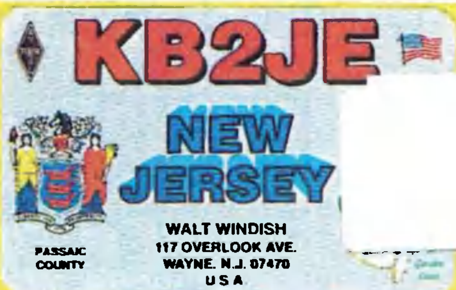
Capacity Meter



Reviews:
Wilderness KC1
Stealth 10-40m Antenna
Hamtronics TD-4
Index Labs QRP-Plus



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On the cover: Peter Summers N2XTT shared with us a few of his QSL cards to make our attractive cover this month. We are especially interested in his creative card made for Jordan . See story on page 10.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Wanted: Role Models

A Silent Key note, sent in by a friend of the deceased, cited the wonderful things the SK had done. My reaction was one of frustration and disappointment. Why in blue blazes did this "friend" wait until the guy died to write something nice about him?

One of my readers recently sent me a tape of a "Nova" program about Dick Feynman, the Nobel Prize-winning physicist. I'd seen the program when it originally was shown, but it was fun to see it again. Too bad if you missed it. Even more too bad if you haven't bought any of the Feynman books. I tried to get you to buy *Surely You're Joking Mr. Feynman.*

Anyway, Feynman explained that he had no interest in honors. That resonated with me. That's one thing about working with my old college that has annoyed me. Colleges tend to think almost totally in terms of honors. Phooey.

Sure, I'm a past president of the Peterborough Chamber of Commerce. Big deal. But I am happy that as president I was able to build the membership up by over ten times. And when I was on the local hospital board I helped them save nearly a million dollars. When I was a member of the board of the NH High Tech Council I came up with the program that is now the mainstay of the organization.

Look, if you've got a ham hero around your area who has been accomplishing things, why wait until the guy dies to let the world know what he's done and doing? I don't want honors and titles, but that doesn't mean I wouldn't like to be recognized for some of the things I've done to help inch the world along a little. I'll bet you've got some movers and shakers who would appreciate knowing that their work hasn't been totally unnoticed. So let's see some articles submitted for 73 which will both help thank them (while they are still alive) for their accomplishments, and maybe serve as role models for the rest of us.

Maybe the chap has held an ARRL position. Like an SCM. Fine, but what did he accomplish of some lasting value as a result of that? How specifically has he or is he helping to improve our hobby? Very few hams I can think of who have contributed significantly to our hobby were ever publicly thanked while they were alive.

Gus Browning W4BPD gave tens of thousands of DXers a bunch of new countries. He then entertained hundreds of thousands of us with the wonderful published stories of his adventures. As far as I know Gus never won any honors. No awards. But he contributed enormously to our hobby. I don't remember anyone writing an article about Gus, thus helping us to thank him for what he did for us.

You write the articles and I'll make the space available to help let the hams who are working to make this a better hobby know we appreciate what they're doing and have done. How about an article on Bill Pasternak WA6ITF and his Newsline work? Or Dave Bell W6AQ and his ham promotional films?

Now get your word processor busy and don't forget some good pictures and a disk copy of the text. We've got a bunch of unsung ham heroes who should be sung about before they die.

Are You Illiterate?

My dictionary defines "illiterate" as "lacking education, untaught, and unable to read and write." Since you are reading this, we can eliminate the "unable" part. But that still leaves us with "lacking education." The current term for this is "functionally illiterate." So let me get in your face and ask a rude question. I've been recommending quite a few books in my recent editorials. Okay now, how many of them have you bothered to buy and read? Hmm. I thought so.

Sure, I get a scattering of letters from readers thanking me for putting them onto the books I've recommended, but the other 99% of you have been silent. Which is a blessing, since my mail is already more than I can handle. And some readers wonder why I'm not answering e-mail hourly. Zut, alors!

It's bad enough that our terrible school system has turned most of us into turnips...now they're doing it to our kids and we're too brain-dead in the water to even put up a whimper. And the government, in league with the teacher's unions, is all geared up to turn your grandchildren into turnips too. Lacking creativity, a knowledge base, or even the interest to build one. Did you see the movie "Clueless?" Or "Kids?" Oh, you're waiting for the video version so you can sit and watch it at home, eating chips and drinking a few cold ones, right?

There's a tape I'd like you to send for. It's a lousy $5 (that just helps cover the costs of mailing) and if it doesn't shake you out of your torpor and get you interested in finding out more about what's gone wrong with the American school system (note: I can't honestly call it an educational system), then you deserve to be a dedicated League Life Member.

The tape is by the president of Hillsdale College. That's in Michigan. In it he explains what's gone wrong with our colleges...which are educationally, financially, and spiritually bankrupt. As President George Roche puts it. Hillsdale is the most politically incorrect college in the country. Well, he's an iconoclast. He's been president of the college for 24 years and it's one of the most outstanding colleges in the country. Yes, I know you're a ham and therefore you are cheap, but this one time spring the $5 and find out what's going on. It's a tape I think you'll play over and over in your car. I know I have. Send your $5 to Hillsdale College, Hillsdale MI 49242-1298.

Once I have your attention, I'm hoping to get you to get a copy of Thomas Sowell's *Inside American Education*, Free Press 1993, 368p, ISBN 0-02-930330-3, $25. I hope you've been reading Sowell's columns in *Forbes* and *Conservative Chronicle*. You can find *Forbes* on any newsstand, but the *Chronicle* is by subscription only, at $42 a year; call 800-888-3039. It's weekly and has some good stuff in it, though as you say about my editorials, I sure don't agree with everything conservatives hold dear.

The most important thing you leave behind in this life is your kids. So why aren't they more important to you? Today's parents (a product of our school system) are largely ignoring their kids. They start out by permanently harming their children by smoking and drinking before and during pregnancy. Then they let the hospital put the babies into their nursery instead of staying with the mother. Then comes four years of almost total neglect known as day care, followed by 12 years of our mind-numbing school system (did you read *Dumbing Us Down*, like I asked?). All, including massive parental neglect, at every step of the way. So we end up with exactly what we've nurtured: unmotivated, ignorant, unruly kids. And we wonder why they "go bad." Why they are into drugs and getting pregnant. Gee, big surprise!

Look, we got rid of King George and what used to be Great Britain, but is now Britain, a couple hundred years ago. If we can take our eyes off our TV soaps and sitcoms long enough, we can work together and fix our school system...and all the other niggling problems we've let our government create and nurture for us while we've been too busy enjoying life to pay attention...like drugs, crime, welfare, the deficit, a bureaucracy that's now larger than our manufacturing industry base, our crooked Congress, and so on.

You can start by getting the tape. And then drop me a line telling me how you don't always agree with me. About what?

Just A Coincidence

Have you been keeping up with your reading? There are several good books on chaos theory. Read any of them? How about synchronicity? You know, coincidences.

How about this one, from *Incredible Coincidences* by Alan Vaughan. In 1893 Henry Ziegland, of Honey Grove, Texas, jilted his sweetheart, who then killed herself. Major bummer. Her brother tried to get even by shooting Zieglaud, but the bullet only grazed his head and buried itself in a tree. The brother, thinking he'd killed Ziegland, committed suicide. Guess it ran in the family. In 1913 Ziegand was cutting down the old tree with the bullet in it. It was a tough old tree, so he used some dynamite. The explosion sent the bullet through his head, killing him.

The book is full of such remarkable "coincidences."

Another book, Serendipity... Accidental Discoveries in Science,

Continued on page 8

Number 6 on your Feedback card

LETTERS

From the Ham Shack

Raphael Escoe DDS WA2MMT. Re your editorial on AIDS, the law requires that medical workers wear gloves when working with patients to prevent the spread of AIDS, TB, etc. My electrical tests show that three of five brands of latex gloves leak after 20 minutes of use. All vinyl chloride gloves leak. This presents an opportunity for hams to design and sell a gadget which will sound a buzzer if the gloves leak. One electrode would be hooked to the doctor or nurse, perhaps with a wrist band, and the other to the patient. This would make a great how to build it article and a great little gadget to manufacture. It might also be used to verify condom integrity.

How about it? Will I be seeing some articles on clever alarm designs? . . . Wayne

Mel Mahler WB9MAF. Your December editorial leaves the wrong impression as to the purpose of CTSS and who may use a frequency. Twenty years ago it was evident that when one lived eighty miles from a swamp full of alligators (Chicagoland), something was required to maintain the sanity of control operators. The answer was to require CTSS to activate repeaters. It didn't stop high powered ops in the city from capturing the repeater receiver, but there was no transmission until a local station had access. Over the years most rigs now come with capability built in (if you can find the book to translate the settings) and consensus was reached on a plan (one CTSS tone per area code in Indiana). No reasonable amateur mentality should ever construe that requirement for CTSS equals a "private" repeater. In fact, there is much doubt in my mind that such a thing can or should exist on the amateur bands. Private repeaters sound much more like a commercial service and private frequencies don't even exist there. Those amateurs that don't fit in the above mentality are left to their own groups, usually around repeaters that are so antagonistic as to account for only their presence. I know you write editorials to cause thought, but please start the process from a reasonable point.

Yes, I'm well aware of the legitimate use of CTSS, but when I visit city after city where there are no such extenuating circumstances and find the repeaters almost 100% CTSS restricted, some other explanation is inescapable . . . Wayne

Larry Reitz WA8CWD. Earlier this month I had a problem with my Ramsey FX-146 transceiver. After replacing the T/R switching transistor I found the receiver had gone deaf. After further examination I found the preamp transistor was dead, probably from my having pumped the transmitter output into it. Unable to find a replacement for this transistor I called the Ramsey tech support. To my surprise their receptionist had a replacement sent the same day. Two days later it arrived and I installed it and was back on the air. Not only was I surprised to get such a fast answer, but to receive the part that fast was amazing. The Ramsey staff is really on the ball. Not having to run up a monstrous phone bill running through a dozen touch tone sequences to finally be told to leave a message that no one ever responds to was a pleasant surprise. All ham radio and computer manufacturers should look to them as an example of how to treat customers. You can bet that I'll be buying more Ramsey equipment. Ramsey not only sells high quality kits, but they provide superb support when you need it.

Name and Call Withheld By Request. Wayne, if we could eliminate federal welfare this would help eliminate crime. People would have to go find work. They wouldn't have so much time to get into trouble. Additionally, they might be too tired when they clock out to go out somewhere and start some trouble. They would have more self respect and maybe, just maybe, some of that would be directed to more respect for society at large. It wouldn't work for everyone, of course; no program would be 100% effective. What about those people that really need help? The churches and charitable organizations can step in; some of them already do. I have a tremendous amount of respect for the work the Salvation Army does.

I used to be the editor for the local ham club newsletter. I quit, both being editor and being a club member. I'm 48, and was one of the youngest members. If anybody read the newsletter, I couldn't tell. I put out questionnaires, held contests, asked for volunteers to be technical assistants, tried to set up Saturday workshops to introduce members to packet, satellites, computers, 220 or 440 MHz activity. The end result? Zilch, zero, nada. No one would even submit articles on any item they had bought or constructed, or any interesting QSOs they had experienced. Unfortunately, in talking with members of clubs in other cities, they say the same holds true everywhere: Old white men set in their ways. What can we do? Leadership is the key. Dynamic young(-minded) people need to join the stagnant clubs, and get involved. You don't have to try to get the old-timers interested in something new; just get acquainted. Bring in new members who have an interest in newer ideas, like packet or satellites. You need not push the dead weight aside; just make room for the newbies. I used to write in the newsletter and say out loud at the monthly meeting that there was plenty of room in the club for different interests. There might be more people interested in DX contests than in packet, but you could do both if you wished. It was your choice; participate in any aspect you wish. For a while, with the no-code Techs, we got some fresh blood in the club. We even had enough volunteers to provide communications for a city event. However, there was no encouragement from the older members, so the younger ones lost interest and drifted away. The only school-age members we picked up (two!) were children of adult members. There are a few interesting people in the club, even now, but they don't take an active part. The same people stay in the same offices. Maybe we should have term limits! Well, the city is a retirement community, so most of the people who join the club are retired; when they die off, other retirees take their places.

How do we get in the schools and attract kids? I don't know. Some of us members went to the local schools, public and private, and gave short presentations on amateur radio. The end result? You guessed it: No response; no questions from the audience; no comments. In one instance, they showed up just to get out of history class. The few young people I meet are not interested, especially when they hear the terms "study" or "exam." This leads us back to the fault of public (mis-)education. A kid can do nothing more than sit in a room for 12 years and he knows that he won't be denied a diploma. He never considers landing or keeping a job. This might date me as middle-aged, but it seems most young people are interested in chemical entertainment (drugs or alcohol), sex, and the acquisition of material goods (cars or clothes). So many don't want to work for anything anymore. Perhaps they realize that the main qualification to get a job is to be a member of a "minority" group. Yes, that's a barb. Point made, most employers won't keep an incompetent worker; maybe government or teaching jobs, but not privately owned smaller businesses. Fundamentally, the problems with public education begin with the parents. As they turn more and more responsibility over to others to raise their kids, so the kids become a product of the system. If the parents are interested in their kids and their kids' future, it shows, and the kids are more interesting to be around.

That's enough for now. I will write again sometime. Hopefully, you will read this letter and want me to write again. Keep writing in your column about books that you find interesting; I have been able to find a few of them at the used book store.

Before welfare we didn't have people starving, even in the depths of the Depression. We had soup kitchens and so on. Rather than being a safety net, welfare has become an easy alternative to working. I hope some readers bothered to watch the TV program on welfare, showing two big, fat, lazy Lebanon, NH, women who had no interest in ever working. Now, I can understand why you couldn't get the club members to write. I have about 100,000 ham readers and I can't get many of them to write either. So I can imagine the problems you had with a club of 30-50 . . . Wayne

Arthur Harris KC6WZJ. The other night, suffering with insomnia, I turned on the radio and very luckily caught the beginning of your conversation with Art Bell. I listened to the whole three hours of your complete talk. Very enlightening to say the least. I heard what I never thought I would ever hear...a keypounder saying that code was anything less than God's gift to mankind. Boy, you must really catch a lot of flak for that heretical point of view. The boys down at ARRL and all the other keynuts must be demanding that your license be permanently revoked. I am subscribing precisely because of that view. As an older ham, but young as a licensee, I really resent the fact that as a no-code Tech I have such restricted band availabilty. I got my license soon after the no-code became available. I especially resent that individuals with higher class licenses have such doubtful technical competance. Recently at a ham meeting during a conversation I referred to three-phase power. Another ham (with HF privileges I don't have) asked what three-phase power was. He not only didn't know what three-phase power was, he didn't know what single-phase power was either! Boy, it's a good thing I didn't bring up wye and delta three-phase.

I feel that the difference between CB and amateur radio is technical ability and radio discipline. Basically, code is obselete. The code requirement is analogous to requiring the 1st Cavalry Division to wear riding pants and high boots and ride horses every day. Some people enjoy riding horses and some people enjoy code. This is their right, but to force it on others is not.

Art obviously has never read 73 or he'd never call me a keypounder. Computer keys, sure. Teletype keys, absolutely. But instead of no-coders griping about the code barrier I wish they'd either shut up, buy my $7.95 blitz course in learning the 13 wpm code the easiest way known to man (or even woman), or start doing something to get the ARRL to recognize that the day of radio relaying by Morse code may soon be over . . . Wayne

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QRX . . .

Fight Winter Blues

If your DX life has been in the dumps due to the solar lull and winter conditions you might find the following bulletin of interest. It was pulled from rec.radio.amateur.misc, one of the Internet news groups dealing with amateur radio. If you point your web browser at the URL (universal resource locator or web address) http://solar.uleth.ca/solar you will find yourself at an almost real time propagation forecast site. The available information can be used for everything from aiming your beam for that great circle route to deciding if you should just stay in bed, read the latest issue of *73* and wait for conditions to improve.

New WWW Radio Propagation and Ionospheric Services Are Now Available

http://solar.uleth.ca/solar

Our main homepage has been supplemented with several new ionospheric services that should be of wide interest to radio communicators (amateur and professional).

Every hour, approximately 15 to 20 minutes past each hour, our system regenerates five real-time globally contoured maps of various important and useful quantities:

1. Global Maximum Usable Frequency Maps. (http://solar.uleth.ca/solar/www/realtime.html)

2. Global Maps of the F2-Layer Critical (Penetration) Frequency. (http://solar.uleth.ca/solar/www/fof2.html)

3. Global Maps of the E-Layer Critical (Penetration) Frequency (foE). (http://solar.uleth.ca/solar/www/foe.html)

4. Global Maps showing the Height Maximum of the F2 Layer (or the altitude above the surface of the Earth where the ionospheric electron density is highest). Information regarding the likelihood of non-great-circle propagation can also be determined. (http://solar.uleth.ca/solar/www/hmf2.html)

5. Global Maps of Solar Zenith Angles, or the distance of the Sun away from the zenith (the point in the sky that is exactly overhead). Shows the elevation angle of the Sun above or below the horizon for any location on the Earth. (http://solar.uleth.ca/solar/www/zenith.html)

Each map includes the plotted solar terminator (sunrise/sunset line), the gray-line corridor where the Sun is up to 12-degrees below the horizon, the location where the Sun is directly overhead, and the locations of the auroral ovals based on the latest 24-hour planetary A-index (updated every 3 hours).

To our knowledge, these services form one of the most extensive set of near-real-time maps pertinent to radio propagation and radio navigation on the Internet.

FAR Scholarships Available

The Foundation for Amateur Radio, Inc. plans to administer 57 scholarships for the academic year 1996-1997 to assist licensed radio amateurs. The Foundation, comprising more than 75 local area amateur radio clubs, fully funds eight of these scholarships with the income from grants and its annual hamfest. The remaining 49 are administered by the Foundation without cost to the various donors.

Licensed radio amateurs may compete for these awards if they plan to pursue a full-time course of studies beyond high school and are enrolled in or have been accepted for enrollment at an accredited university, college or technical school. The awards range from $500 to $2,000 with preference given in some cases to the pursuit of certain study programs or to residents of specified geographical areas such as Delaware, Florida, Maine, Maryland, New Jersey, Ohio, Pennsylvania, Virginia and Wisconsin. Amateur radio clubs are encouraged to announce these opportunities.

The Foundation for Amateur Radio, incorporated in the District of Columbia, is an exempt organization under Section 501 (C)(3) of the Internal Revenue Code of 1954. It is devoted exclusively to promoting the interests of amateur radio and those scientific, literary and educational pursuits that advance the purposes of the amateur radio service.

Information and application forms may be requested prior to April 30, 1996 from: FAR Scholarships, 6903 Rhode Island Avenue, College Park MD 20740.

Hams In The Snow

In typical fashion, the amateur radio community mobilized and provided coordination and emergency communications for the blizzard that hit the east coast in early January. In places like Montgomery County, Maryland and Suffolk County, New York hams in four wheel drive vehicles helped out area hospitals, provided coordination of food and supplies for the sick and elderly and did the things that amateur radio operators do every time an emergency comes up.

So... what's so special? What's the big deal? Nothing except that with all the intense media coverage no one took the time to tell the story to the public. Based on a sampling of hams talking about this no-press phenomenon, feelings are mixed. Many hams think its part of the package - if you have a license you should be there to help by using your skills, equipment, training and time. This, indeed, is the true spirit of amateur radio and should be commended. But there are a good number of operators who feel a little publicity wouldn't hurt when antenna restriction time or band allotment discussions come around. The answer as to what to do is best explained by a ham who posted on an internet discussion group. "Do the best you can to help your community in an emergency but also keep your local and state media outlets aware of Who's doing What, Where, When and How. Names, addresses, telephone numbers! Make it easy for the media to tell a positive human interest story and they will!"

Never Say Die

Continued from page 4

by Royston Roberts, John Wiley, 1989, $13, 270p, ISBN 0-471-60203-5, has a bunch more "coincidences." Like the way Daguerre invented the Daguerreotype, the first practical photographs. He'd been able to make faint photos on silver-coated copper plates, but they weren't bright enough to be seen easily. He tried every way he could think of to intensify the image. Then, one day, he put an exposed plate in a cupboard which had some chemicals in it, planning to clean the faint image off and reuse the plate. When he took it out a few days later he found the image had been intensified!

So he tried each of the chemicals in the cupboard, but none worked. He then looked closer and found some drops of mercury which had come from a broken thermometer. And that's how the Daguerrotype was invented. Unfortunately, mercury is very poisonous, so many early photographers died of mercury poison. These days we're still making people sick and killing them with mercury, courtesy of your local dentist, who is still using it in your amalgam fillings. Well, at least it's a slow poison.

I remember running an article in *73* many years ago about the almost discovery of the transistor. A couple hams had run into the semiconductor phenomenon while experimenting, but the importance of it had escaped them. You have to have curiosity and be open to new paradigms. Velcro was invented by a chap who wondered why cockleburs stuck to his clothes so tenaciously.

Serendipity can give you the hints, but it's up to you to turn this into inspiration. Take off your blinders! Whatever it is that causes these coincidences is still at it and will work for you, if you'll only let it. Or maybe you honestly believe that every single one of the tens of thousands of sincere stories about angels helping people are bogus.

Ancient History

First, I'd like to tell you about the time I called an admiral a traitor, and then, to how this led me to get the inside scoop on ARRL General Manager Budlong, W1BUD.

This all started when I was the editor of *CQ*, one of the ham magazines. I'd been summoned to the Pentagon for a briefing. Briefing? It was anything but brief. An Air Force colonel obfuscated for over an hour, speaking Air Force jargon, which I translated as best I could into English. It had to do with the Air Force needing to take over our 450 MHz band for a new radar project.

When he got through, I asked if what I'd heard translated into the Air Force, faced with the problem of the Russians using radar jamming equipment in their bombers, was being countered by our setting up so many radar systems that even a fleet of bombers couldn't jam them all? To make room for this mass of radar systems we hams would have to give up our 450 MHz band to make

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JY74X-JY74Z: A Joint Jordanian-Israeli Operation

One peace process dividend: DXpeditions to Amman and Mt. Nebo, celebrating the first anniversary of the "Washington Declaration" peace accords.

Joe Obstfeld 4X6KJ-JY8KJ
PO Box 873
Kiryat Ono 55000 Israel

The preliminary arrangements had been going on for a very short period of time. Everything was set and the final word would be coming from the Royal Palace in Amman, depending on His Majesty's schedule. Word of the proposed date was transmitted by fax to Amir 4X6TT, and he made all the calls and arrangements.

On Wednesday evening I received a call, just stating that I was requested to join this operation, and that the team was leaving on Monday the 24th of July. I asked just a few questions: Who is going? Where do we stay? What about a visa for Jordan? What about transportation? etc. The answer was simple: "It's all been taken care of, just come."

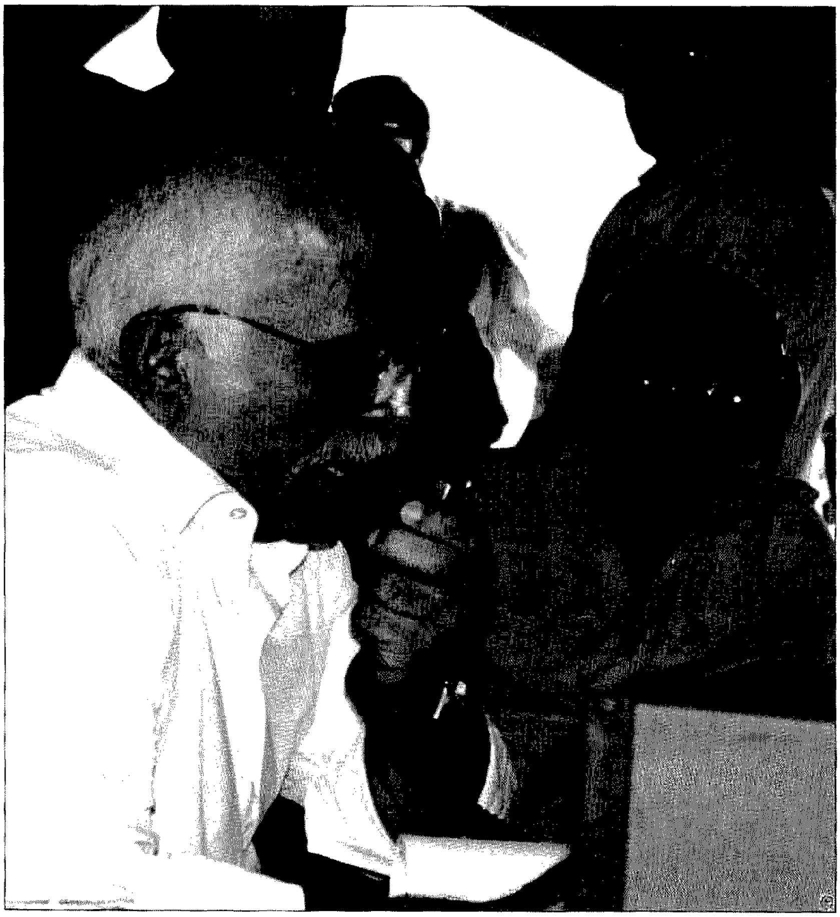

Photo A. King Hussein JY1 operating JY74Z on Mt. Nebo.

I was doubtful and couldn't believe it until I phoned the Secretary of the Jordanian Amateur Radio Club, Mohammed JY4MB, with whom I've been in regular contact. We'd met many times at international conferences and had spent many hours planning and discussing joint cooperation between our two societies.

"What resulted was monstrous; it unleashed a free-for-all."

He was pleased to tell me, "I'll see you in a few days here in Amman." He confirmed the entire plan, saying, "What are you worried about? Everything is taken care of, just make sure that at 10 a.m. on Monday you're at Allenby crossing. Salaam, Shalom, see you on Monday!"

After checking my passport's validity, I dug up a small suitcase, prepared film and batteries for the picture and video cameras, and I was ready to go.

JY74X Amman

At precisely 7 a.m. the rented minivan limousine passed through the heavy early morning Tel-Aviv area traffic and continued on to Jericho in the Jordan Valley. The van was loaded to the brim with equipment for the mission, as well

as with the operators Ami 4X4DK, Amir 4X6TT. Moni 4X6ZK. Dov 4Z4DX. Eyal 4X6RE and me. All of us were fascinated with the speed and efficiency of the preliminary arrangements for this DXpedition. During the two hour trip to the border. the team was discussing in anticipation what might be awaiting us.

At the Allenby bridge, the Jordan-Israel border crossing, everyone involved did his utmost to make our passage as fast and easy as possible. No wonder! The border officials had received advance notice of our program and the intended operation by none other than the Royal Court in Amman, as we later found out. It was the first time ever that Israeli radio amateurs would be crossing the border to operate with Jordanian amateurs in their country.

"It was the first time ever that Israeli radio amateurs would be crossing the border to operate with Jordanian amateurs in their country."

Within 30 minutes of our arrival at the border the gate was opened and our minivan was allowed to bring our equipment to the other side. It was quickly transferred to one of the Jordanian vehicles that was awaiting us. After greeting Mohammed JY4MB. who came specially to welcome us, and be our escort, we made our way in a convoy of Royal Palace cars to Amman, the capital of the Hashemite Kingdom of Jordan.

First we checked into our hotel, put our personal belongings there, and after a quick lunch we made our way to the clubhouse of the Royal Jordanian Amateur Radio Society. We unpacked the equipment from the van and started to set up the different stations. Within an hour of our arrival, the first station, JY74X, was on the air. We were joined by our Jordanian friends, and as the day progressed more transceivers were pressed into service on different bands and modes.

JY74Z Mount Nebo

Three members of the group went with an escort to Mount Nebo, about 60 km. southwest of Amman, to check out the site and to start setting up so that on the 25th of July operation JY74Z from this site could begin. It was especially important to get on the air on this day, as the whole mission was dedicated to the first anniversary of the Washington Declaration, which was signed at the White House. One year after signing the Principles of Peace between Jordan and Israel, radio amateurs of both countries got together to put this DXpedition on the air and handle the pileups.

Early in the morning on Tuesday, July 25th, the entire team assembled in the hotel lobby and our awaiting Royal car and escort took us to Mount Nebo, elevation about 800 meters above sea level, an hour's drive from Amman. As soon as we arrived we began operating. One by one the transmitters fired up on the air on SSB and CW. Frequently we had to change operators, because of the terrible 40° Celsius (104° Fahrenheit) heat that prevailed at the time in our tents. The pileups were ear-shattering. After supper, provided by the Marriott Hotel Catering Service and brought to the mountain site, the team split into two groups. One stayed overnight on Mount Nebo, in the seemingly freezing cold. Temperatures in the desert change dramatically to extremes during day and night. The other group went down to the city, to operate from the clubhouse in Amman.

JY1 Incites Bedlam

The next day the program was the same as the day before, but the heat was worse. The highlight of the day was the appearance of none other than His Majesty King Hussein JY1 on the air on both HF and VHF. The excitement and enthusiasm increased as everyone of the team present had a chance to have a QSO with His Highness from his Palace in Amman. Afterwards the pileups doubled, the frenzy on the HFs went out of control and His Majesty decided to QRT and maybe appear later and try again.

Around 5 p.m. we were honored as His Majesty arrived in person at the Mount Nebo site. After introducing ourselves, he went on the air: "This is JY74Z. JY1 at the microphone." A few QSOs were made, but it was almost impossible to pick out a callsign through the roar of the pileup. The word most used during that half hour or so was "stand by, stand by." Amateurs around the globe just did not listen, each one thinking that he will make it through. But only those who have been on the other end of a pileup know that the colossal noise created at such moments gives cause for the big switch being pulled. His Majesty put down the microphone and signed the log. For a few lucky ones this will be the most unforgettable and special QSO ever. Meanwhile refreshments were being served, and a lively, pleasant eyeball QSO ensued.

The Final Day—Almost

Thursday July 27th was supposed to be the final day. During the morning hours our driver took all of us on a sightseeing tour of the city, after which we returned to The Mountain and continued working the pileups. As the day progressed it became clear to us that it could not be the final day of operation, as on Friday the Jordanian part of the border is closed and on Saturday the Israeli side is shut down. At various times during the day His Majesty JY1 came on the HF frequency and the frenzy on the bands continued. During the night it was the same. As word spread that there would be a special QSL card for this occasion, the amateur radio world tried to work the two stations on every band and mode possible.

Friday July 28th, in the morning, we were summoned to the residence of His Highness Raad Bin Zeid JY2RZ, the Chairman of the Royal Jordanian Amateur Radio Society, to receive officially and personally our Jordanian operating licenses. At the end of this eyeball QSO it was decided to go back to work. His Highness JY2RZ would come on frequency and take some calls. Enthusiastically we went back to The Mountain and tried to regulate the pileup as the two most wanted Jordanian callsigns came on the air simultaneously.

What resulted that afternoon was monstrous: it unleashed a free-for-all on the HF bands, uncontrollable even by the best of operators. "Stand by, staaaaand by, quiet!" But nobody listened and the roar continued. The few very lucky ones who "made the contact" must still have adrenaline running through their veins.

At sunset, we took time out for a most elaborate barbecue, prepared for us by

the Marriott Catering Service, with a most unforgettable view as background. From Mount Nebo one can oversee the Jordan Valley, the Dead Sea on one side, Jericho and the river Jordan on the other. As the sun set, the colors of the landscape below and on the horizon were exquisite. Here on this spot Moses went to the top of Mount Nebo and The Lord said to him, "This is the land which I swore to Abraham, Isaac, and Jacob that I would give to their descendants" (Deuteronomy). Later that evening, the pileups reverted to the normal state that we had gotten used to during the days and nights before.

The Final Day—Really

Saturday July 29th, really the last day of this very special operation, we decided that later in the afternoon the stations would be dismantled and antennas taken down. The multitude of equipment that we brought had to be packed and made ready for the return trip. At approximately midday, once more the frenzy peaked, as one more time His Majesty JY1 came on the band from his Palace QTH in the southern city of Aqaba. Unfortunately, the HF propagation was very bad, and very few had a chance for a contact. We at Mount Nebo could not hear him, so the net control was done somewhere in Europe. We left Mount Nebo, had one more look at the unbelievable view of the surrounding landscape and went downhill with all the equipment that had accumulated at the site over the past days.

We made more than 15,000 QSOs on all the bands except 160 meters. Repeatedly we gave our QSL info, so here it is one more time: All QSLs go via JY6ZZ, direct or bureau.

We arrived at the hotel in the afternoon. Tired and dusty, we rested a bit, took a well-deserved shower, and prepared ourselves for the festive dinner that we were invited to by His Highness Prince Raad JY2RZ. At the appointed time we all assembled at his home, where our fellow Jordanian amateurs, who had been with us all the time, joined us. We discussed the pileups, the activity of the past days and the plans for the future.

We were taken completely by surprise when His Majesty King Hussein JY1 arrived and joined us for the evening dinner. Many anecdotes were told and pictures taken. For us six Israeli hams, it was the ultimate climax of an incredibly successful and special DXpedition. We hope that we will have many more opportunities to work together with our fellow hams from JY-land.

On Sunday July 30th we packed the equipment, cleaned up the mess, gathered and signed the logbooks, got our few personal belongings from the hotel, returned the keys and everything was ready for the return trip. Shaking hands and saying good-bye was certainly not easy after such a week.

Photo B. Mohammed JY4MB at JY74Z. The fan? It's 104° F!

Sigh, Back To Reality

Within a few hours we were back in the bustling Tel Aviv traffic. Everything seemed like a dream—a dream that had come true.

Allow me a word of thanks to Amir 4X6TT, who coordinated the whole event, and to the wonderful team of Israeli operators for making this such a memorable week. Special thanks to the JY operators, friends, our partners in the task of controlling the pileups. It was great being together with you for this momentous and historical performance. Mohammed JY4MB, Secretary of RJARS, did an amazing job of orchestrating, guiding, and supporting the whole operation, from the beginning until the end. Special thanks for his endurance in staying with us the whole time. And thanks to Ibrahim JY5EV, for the endless technical support, for keeping the towers and antennas up and the amplifiers running.

Thanks too to Ali Shoukri JY3AK of the Royal Palace, for the intermediary, logistics and support. There are no words to describe the appreciation and gratitude from all of us to His Majesty, King Hussein of Jordan, JY1, for all you have done for us. Without your personal involvement and assistance this event could not have come to pass. Salaam—Shalom.

Editorial Note

Having operated from Amman as JY1 and JY8AA, it was particularly enjoyable for me to get this report of the joint JY/4X team at Amman and Mt. Nebo. I've been to Mt. Nebo and looked out over the biblical area. If you can, plan on a visit to Jordan, where you'll have no problem getting a JY8 call. And plan to see this small country from Irbid in the north to Aqaba in the south. You'll bring back wonderful pictures of the ruins at Jarash, the pink city cut out of the mountains at Petra, the view from Mt. Nebo, the crusader's fortresses, and the tiled floors of churches at Madaba going back to the Roman and Greek times. Heck, you may even be able to organize a visit with His Majesty! . . . Wayne.

Into Orbit with the Final Phase 3 OSCAR

It's a bird! It's a plane! It's...

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

The Amateur Satellite Program has come a long way since the launch of OSCAR-1 on December 12, 1961. OSCAR stands for Orbiting Satellite Carrying Amateur Radio. OSCAR-1 was built by Project OSCAR, a West Coast group. The launch took place only four years after that of Sputnik-1 from the Soviet Union. OSCAR-1, weighing in at 10 pounds and costing about $64, carried a 140 milliwatt CW beacon transmitting "HI" on 145 MHz. The transmissions lasted 22 days till the satellite re-entered the atmosphere from its very low earth orbit.

Since then there have been many amateur satellites, some simple, and others supporting many complex experiments and transponders. We have had satellites with simple telemetry beacons, with voice and CW transponders like repeaters in the sky, and with complex, digital store-and-forward flying BBSs, or radio bulletin-board systems.

Phase 3-D is the largest, most complex and international "hamsat" project to date. It is scheduled for launch from French Guiana later this year on board an Ariane-5 booster. The main body is nearly seven feet in diameter and three and a half feet tall. With solar panels extended, the wingspan is over 20 feet. The satellite weighs in around 500 pounds with an estimated program cost of 4.5 million dollars. When Phase 3-D achieves orbit it will be given an OSCAR number, perhaps AMSAT-OSCAR-29, or something in the low 30s, depending on the schedules of other projects waiting for launch in 1996.

Support for this immense program comes from AMSAT groups around the world. No one ham organization has the resources to plan, build and get a ride to orbit for a satellite of this magnitude.

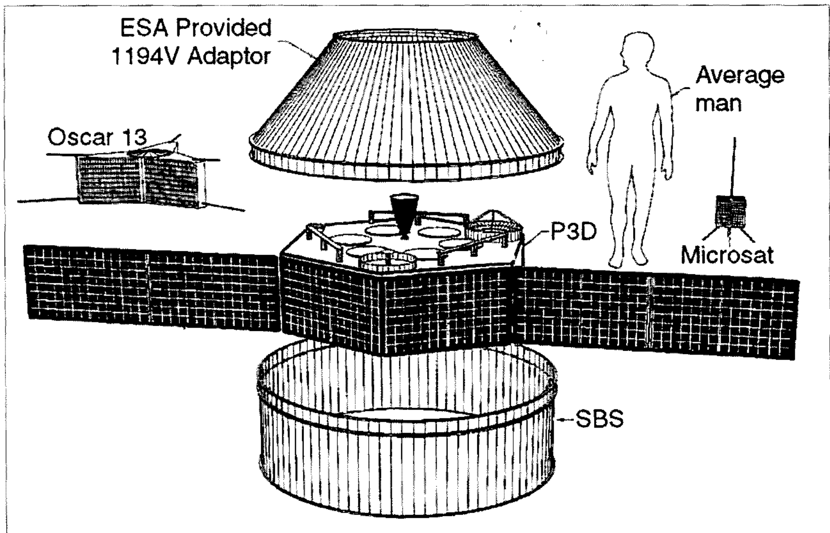

Fig. 1. The Phase 3D spacecraft.

What is AMSAT?

AMSAT stands for Radio Amateur Satellite Corporation. The original AMSAT was founded in 1969 in the District of Columbia as a non-profit educational organization dedicated to foster amateur radio's participation in space research and communication. The first project for the new corporation was getting a launch for Australis-OSCAR-5 in 1970. This was to be the last Phase 1-type satellite, i.e. low-earth-orbit and short life.

"OSCAR-1 weighed 10 pounds and cost about $64. Phase 3-D weighs around 500 pounds and the estimated cost is $4,500,000."

The second project for AMSAT was the first Phase 2-type satellite, AMSAT-OSCAR-6. The Phase-2 classification requires that the hamsat be designed for long life. A-O-6 was expected to last a year with solar cells and rechargeable batteries. It lasted over four years till the batteries shorted out. Today we have OSCAR satellites built by many groups around the world and the "numbers" are increasing rapidly. There have also been several RS satellites from the previous Soviet Union. With many groups using the AMSAT name, like AMSAT-DL of Germany and AMSAT-SA of South Africa, the original group in the United States is now called AMSAT-NA for AMSAT North America. Funding for Phase 3-D comes from membership dues, individual and

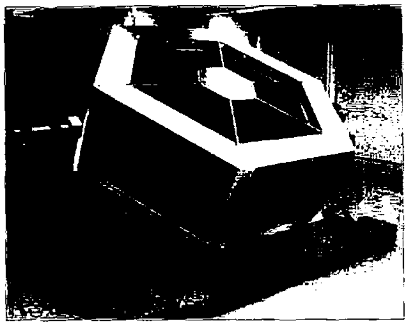

Photo A. The Flight Model Phase 3-D Spaceframe inside the clean room facility. The specially built handling structure will allow easy access to all parts of the satellite during integration.

corporate donations. The American Radio Relay League has been instrumental in financial support of the 1.5 million dollars (cash, labor and components) pledged by AMSAT-NA.

AMSAT-NA provides a vast array of services to support those interested in learning about amateur-radio satellites. To help track each satellite, the AMSAT Software Exchange makes tracking software available for most popular personal computers. AMSAT also runs its own QSL bureau and awards program for satellite users.

The AMSAT-NA Field Organization is ready to help those looking for information on a more personal level. With over 100 Area Coordinators, there are some in most localities willing to answer questions about the satellites, arrange for demonstrations or provide talks for local clubs and ham conventions.

AMSAT-NA sponsors regular HF nets with the latest news on satellite activity and Phase 3-D progress. One of the most popular nets is held every Sunday at 1900 UTC on 14.282 MHz USB. In addition there are many VHF nets around the country with similar information coverage with supplementary local items of interest. One local net, the Houston AMSAT Net, can be heard across most of North America at 10 p.m. Central Time via Anik E2, Transponder 18, 5.8 MHz audio subcarrier. It is also carried by various VHF and UHF repeaters in addition to a 160-meter feed on 1860 kHz AM from WAØRCR in Missouri.

Current AMSAT information is also available via the Internet. A World Wide Web page can be found at *http://www.amsat.org*. There is also a 'ftp' site at *ftp.amsat.org*, and up-to-date discussions about Phase 3-D and other topics can be checked out by subscribing to *amsat-bb@amsat.org*. Just send a message to *listserv@amsat.org* to subscribe. More information about AMSAT, telephone BBSs and nets can be obtained for a self-addressed stamped envelope to AMSAT, 850 Sligo Ave., #600, Silver Spring MD 20910.

Why Phase 3-D?

With so many amateur-radio satellites in the sky, why build such a large and expensive one? The current satellites have limitations that Phase 3-D is designed to answer. The Phase-3 series of amateur-radio satellites are designed for long-life and wide, simultaneous, geographical coverage. They are built to last several years and have high orbits.

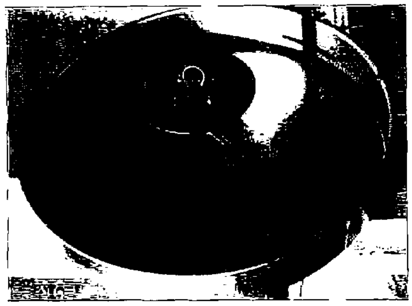

Photo B. The completed Phase 3-D flight model L-band antenna undergoing gain and pattern testing at the integration facility's antenna test range. Preliminary gain measurements exceeded 15 Dbic with a surprisingly clean pattern.

"Every day large volumes of E-mail, pictures, voice files, programs, bulletins and telemetry are sent via low-earth-orbit digital satellites. Phase 3-D will also provide connections between ground-based computers and remote users in real time."

The current Phase-3 satellites include AMSAT-OSCAR-10 and AMSAT-OSCAR-13. A-O-10 was launched in 1983. Although the on- board computer is no longer working due to radiation damage in the memory system, the UHF to VHF linear transponder is still operational when the solar cells are receiving enough sunlight to power the radio gear. A-O-13 went into orbit in 1988. Although most of the systems still work well, the satellite's orbit will decay in December of this year due to orbit instability caused by gravitational effects of the moon and sun. Phase 3-D is designed as a replacement for A-O-10 and A-O-13, with some significant extras.

A-O-10 and A-O-13 provide excellent coverage with their high elliptical orbits, but the orbital characteristics of both require significant tracking programs to predict future access from a specific point on the earth. The apogee or high point of their orbits also fluctuate over time from Northern Hemisphere to Southern Hemisphere coverage, and back again. The final orbit of Phase 3-D will not fluctuate over time, but will maintain stability and provide a repeating pattern that will allow users to predict where the satellite will be on any given day and time.

The orbit modifications that will be performed on Phase 3-D after launch is a two-year process to go from the original transfer orbit provided by the Ariane launcher to the final stable orbit. After launch the satellite will have a perigee, or low point, of only 200 kilometers with an inclination with respect to the equator of 10 degrees. The satellite's main motor will raise the perigee by 300 kilometers and the apogee by 8,000 kilometers. The long-duration ammonia arcjet motor will provide a very low-energy thrust to bring both the perigee height up to 4000 kilometers and adjust the inclination to 63.4 degrees. This inclination is stable and will not drift over time for the desired elliptical orbit. The satellite will provide optimum performance for users in the Northern Hemisphere.

A-O-10 and A-O-13 provide good signals for earth stations, but only when high-gain antennas are in use on the ground side. A primary goal of Phase 3-D is to improve link margins by 10 to 15 dB on all bands. This means that earth stations will need less power and lower-gain antennas for reliable communication. During periods when the satellite's antennas are pointed directly at the earth, effective communications may even be possible with only omnidirectional antennas, like those on a car.

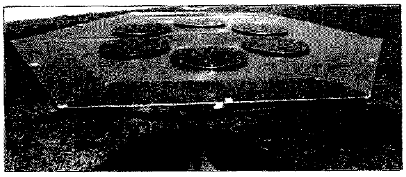

Photo C. The flight prototype U-band patch array undergoes testing on the Phase 3-D integration facility antenna range. The array exhibits measured gain figures comparable to that of a commercial 40-element crossed yagi. Actual on-the-air contacts, with surprisingly good results, have been made through the AMSAT OSCAR-13 satellite using this array as an uplink antenna.

The low-earth-orbit digital satellites have shown the advantages and usefulness of computer-oriented bulletin-board systems in the sky. Every day large volumes of E-mail, pictures, voice files, programs, bulletins and telemetry are sent via these satellites. The opportunities have allowed a glimpse of what can be accomplished with orbiting "digisats," but data rates are still limited and the orbits are low, providing short access periods. Phase 3-D will offer several digital experiments, some at data rates that could support digital video, and access times that will be more akin to on-demand connectivity. Rather than acting only as a stand-alone flying computer BBS, Phase 3-D will also provide connections between ground-based computers and remote users in real time. Connecting to or through Phase 3-D via the Internet is a real possibility depending on the use of ground-based control stations.

Another limitation of A-O-10 and A-O-13 is the effect of high- power earth stations "hogging" the transponder. During normal operation, ground-based users share the transponder output power.

Photo D. "Lights! Camera!" AMSAT-NExecutive Vice President Keith Baker KB1SF gives Dave Brody, Segment Producer of the Sci-Fi Network program Inside Space, *an on-camera tour of the Phase 3-D Integration Facility in Orlando, Florida. The program is slated to appear in late spring 1996.*

Each uplink to the satellite's receiver is re-sent by the downlink transmitter, much like a typical VHF-FM repeater, but with a much wider bandwidth. A linear transponder can handle many stations simultaneously by transponding a range of uplink frequencies to a corresponding range in the downlink. When one station transmits excessive uplink power, the weaker users are "desensed," or just seem to disappear. Phase 3-D has a system called LEILA, a German acronym describing an "alligator" sniffer. An over-powered uplink will be isolated and notified by a series of beeps on the downlink to lower the power level. If the situation is not corrected by the ground user, LEILA will apply attenuation to the signal to even the load on the transmitter. Several levels of attenuation can be applied.

Getting Ready for Phase 3-D

Another goal of the Phase 3-D program is to retain enough commonality with existing hamsats so that current user equipment is not made obsolete. Many popular frequencies in the VHF and UHF bands will be used by the new satellite. A station that is set up to operate via A-O-13 Mode "B" (70 cm up and 2 meters down) will find the new satellite an easy transition. For those looking for new bands and higher frequencies, Phase 3-D offers a promising array of frequencies.

The radio system of Phase 3-D is set up as a matrix of receivers and transmitters. Uplinks and downlinks cover the satellite bands from 15 meters up through 24 GHz. Today's Mode "B" becomes Mode "UV." This stands for UHF (70 cm) uplink and VHF (2 meter) downlink. Typical voice and CW communications will be possible via most of the band combinations. Mode "LS" (1.2 GHz up and 2.4 GHz down) may become one of the most popular by the year 2000.

The anticipated lifetime of Phase 3-D is 15 years. It is truly designed for advanced communications into the next century. To prepare for the new satellite, potential users should begin with today's hamsats. Books and other publications are available from AMSAT and the American Radio Relay League. Start with the easy satellites, like RS-10, RS-12 and A-O-27. Then progress to the high-orbit "DX" hamsats, A-O-10 and A-O-13. A

Photo E. A close-up view of Phase 3-D's flight model Propellant Flow Assembly (PFA). Valves and piping on the left side of the unit will be used to fuel the spacecraft's hypergolic propellant tanks on the ground prior to launch, as well as controlling the flow of propellants to P3-D's 400 Newton kick motor while in orbit. Likewise, valves and piping located on the right side of the PFA will be used to fill the spacecraft's ammonia tanks, and later will control the flow of ammonia to the satellite's arc-jet positioning motor.

series of entry- level articles are in the works for *73's* "Hamsats" column throughout 1996. Start now to get ready for amateur radio's next great adventure.

Photos and figures for this article are courtesy of Keith Baker KB1SF, AMSAT-NA Executive Vice President, AMSAT-NA and AMSAT-DL. 73

Number 22 on your Feedback card

What's New In Kits?

Take a gander at some goodies.

Robert S. Capon WA3ULH
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Chapel Hill NC 27514

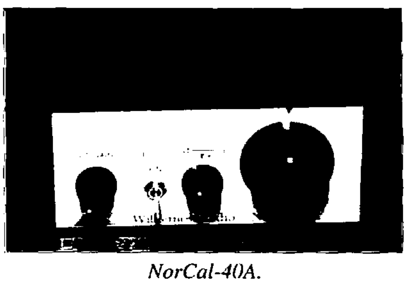
Kit enthusiasts have been rewarded this year with some new kits with great features, and they start at about $100, so there's never been a better time to discover the joy of building your own radio. Your knowledge of amateur radio will be greatly enhanced, and you may discover that one QSO made on your home-brew rig is more satisfying than 10 QSOs made on a commercial transceiver.

This article will provide you with a road map to the latest kits, along with tips and answers to the frequently asked questions for the first time kit builder.

Six Terrific Kits

This article takes a look at six kits: five hot new transceivers and a rather unusual memory keyer (see the full review of the **KC1** in this issue) with a built-in frequency counter. Each transceiver kit features a superhet receiver, and was selected because of its unique characteristics.

NorCal-40A, by Wilderness Radio. The NorCal-40, originally introduced by the Northern California QRP Club, has been reintroduced by Wilderness Radio, a newly formed kit company. The NorCal-40A is ideal for beginners; the jacks and switches mount directly to the board, so there is no point-to-point wiring. This feature makes the radio very easy to build (I put my NorCal-40A together in just two evenings). Wilderness Radio's NorCal-40A comes in a tiny 4 x 4 x 2 enclosure (weighing less than one pound) with a very snazzy two-tone blue paint job. The kit comes with a punched and silk-screened latched enclosure, jacks and knob set, and a first class silk-screened printed circuit board.



NorCal-40A.

"There's never been a better time to discover the joy of building your own radio!"

This 40 meter superhet CW transceiver, designed by Wayne Burdick N6KR, has been optimized for extremely low current drain of only 15 mA on "receive" using headphones. The radio features RIT, AGC, 400 Hz CW filter, and full QSK and delivers 3 watts output. The receiver is absolutely superb. The most challenging aspect of the NorCal-40A is that the builder is required to wind the toroids. First-time builders, however, should not be overly intimidated by this because the radio is supported with excellent documentation.

Sierra, by Wilderness Radio. Again, the Sierra, originally designed by N6KR and introduced by the Northern California QRP Club has been reintroduced by Wilderness. Despite its tremendous sophistication, the Sierra also has characteristics that make it an excellent kit for intermediate builders. Like the NorCal-40A, the jacks and switches mount directly to the board, so there is no point-to-point wiring.

The Sierra is ultra portable, measuring only 5.5 x 6.5 x 2.5 inches (weighing less than two pounds), and has extremely low current drain of 35 mA using headphones. This combination of factors makes the Sierra great for portable and backpacking use, and ideal for battery operation and Field Day.

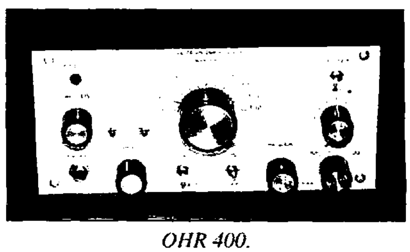
The Sierra can be purchased with up to nine interchangeable band modules for operation on 10-160 meters. The band modules are gold-plated internal plug-in modules. Unfortunately, each band module has eight toroids, so if you intend to build the Sierra for operation on nine bands (like I have), be prepared to wind a lot of toroids. But aligning each band module is a snap, requiring about 15 minutes each to tune up against your main station transceiver.

The Sierra features RIT, AGC, 400 Hz CW filter, and full QSK, and delivers 2 to 3 watts output on all bands. The kit comes with a punched and screened latched enclosure, jacks and knob set, and silk-screened printed circuit board.

OHR-400, by Oak Hills Research. The OHR-400 is a new kit for intermediate to advanced builders. The radio has become my favorite base station QRP transceiver, because it is switch-selectable for operation on 80, 40, 30 and 20 meters, so band changing is effortless.

The OHR-400 also has a superb receiver with silky smooth QSK. The radio really excels at copying very light signals, and it compares favorably with my commercial HF transceiver at digging out stations at the noise level. This makes the radio ideal for milliwatting work. But the OHR-400 is not ideal for backpacking; it has a hefty cabinet measuring 8 x 8 x 4 inches (weighing almost four pounds), and the radio draws approximately 300 mA on receive.

The OHR-400 comes with excellent documentation, and was a pleasure for



OHR 400.

me to build. I really took my time with the radio, and savored the experience of building the kit. The radio has three printed circuit boards that mount on a solid internal aluminum chassis. The boards are the oscillator, receiver, and transmitter. Interconnecting the boards and panel components is accomplished with approximately 50 point-to-point color-coded wires. Again, the documentation for performing the wiring is first class, but this amount of wiring should typically not be attempted by first-time builders. (Oak Hills has other kits ideal for the beginner, like the single band Explorer described below.)

The OHR-400 features RIT, AGC, narrow CW filter, and full QSK, and delivers 5 to 8 watts output on all bands. The kit comes with a punched and screened enclosure, jacks and knob set, and the three printed circuit boards are silk-screened. It has nice finishing touches, including a phono jack on the back with VFO output for hooking up a frequency counter, a rear panel power level pot, an LED lamp, and a knob set and silk-screening on the front panel for an optional keyer. The toroids are pre-wound, clipped and tinned.

Cascade, by NorCal. SSB on 20 and 80 meters. The Cascade is the latest club project by the famous Northern California QRP Club, and was designed by John Liebenrood K7RO. The Cascade joins an elite group of SSB QRP kits, so now phone enthusiasts can discover the fun of building their own SSB transceiver. Despite its similarities to the Sierra in physical design (jacks and switches mount directly to the board, so there is no point-to-point wiring) the Cascade is a kit for advanced builders, and an oscilloscope is very helpful during the test and alignment process.

The Cascade is ultra-portable, with physical dimensions identical to the Sierra, and has extremely low current drain of 80 mA using headphones. So the Cascade is also superb for portable and backpacking use, and ideal for battery operation and Field Day.

The Cascade comes standard with two interchangeable band modules for operation on 20 and 75 meters. The band modules are gold-plated internal plug-in

modules. Each band module has only six toroids.

The Cascade features AGC and speech synthesizer, and delivers approximately 8-10 watts output on each band. The kit comes with a punched and screened latched enclosure, jacks and knob set. and silk-screened printed circuit board. The Cascade's documentation takes the builder through 10 independent stages so that you can trouble-shoot and align the kit as you go.

TAC-1, by S&S Engineering. Synthesized CW transceiver with digital display for 80 or 40 meters. The TAC-1 is the latest in a worthy product line of synthesized transceivers offered by S&S Engineering. Unlike the thumbwheel tuning of its predecessor, the Ark-40, the TAC-1 comes with a convenient tuning knob. With a single press on the tuning knob, tuning toggles conveniently between 1 kHz and 100 Hz steps.

The TAC-1 is an excellent kit for intermediate to advanced builders. Like the NorCal-40A and the Sierra, the jacks and switches mount directly to the board, so there is no point-to-point wiring, and the documentation is excellent. However, the components density of the kit is high, and it would be rather difficult to align the synthesizer without the use of an oscilloscope.

The stability of the TAC-1 synthesizer and the digital readout make the radio ideal for serious beacon work. The radio is also very nice for operators who enjoy having a digital frequency display. The radio draws approximately 225 mA, which is needed to drive the synthesizer and LCD display. So the radio is still fairly well suited for portable use, albeit with a somewhat larger battery than the NorCal-40A or the Sierra.

The TAC-1 features RIT, AGC, narrow CW filter, and full QSK, and delivers approximately 3 watts output. The kit comes with a beautiful extruded aluminum case that is punched and screened and features an attractive plastic bezel for the digital display. The TAC-1 also comes with jacks and knob set, and a first class silk-screened printed circuit board.

The finished TAC-1 is a work of art. The populated printed circuit board is a virtual fiesta of components and colors.

KC1 Keyer, by Wilderness Radio. Memory keyer with frequency counter. Designed by the legendary QRP designer Wayne Burdick N6KR, the KC1 combines an unlikely and extraordinary juxtaposition of functionality: a memory keyer with a frequency counter that reads the frequency in CW!

Measuring only 2.5 x 0.8 inches, and drawing only 4 mA, the KC1 has become the first accessory that I put in each of my home-brew QRP rigs. The kit comes with fewer than 20 components, and can be assembled in about a half hour. Interfacing it to your QRP kit is a bit trickier, because you have to identify the best places to obtain a VFO signal, and fiddle with values of coupling capacitors to make it work. The KC1 also lacks the audio output to drive headphones, so the audio signal of the keyer must be injected into the final audio stage of your rig.

As of the writing of this article, Wilderness Radio was gathering user comments from many of the popular QRP kits, and furnishing interface instructions with the kit.

When finished, the KC1 can be programmed with up to four different VFO offsets to provide three-digit frequency readout accurate to 1 kHz. The KC1 also enables you to key in a three-digit frequency, and will give an alert tone when you dial to within 2 kHz of the frequency!

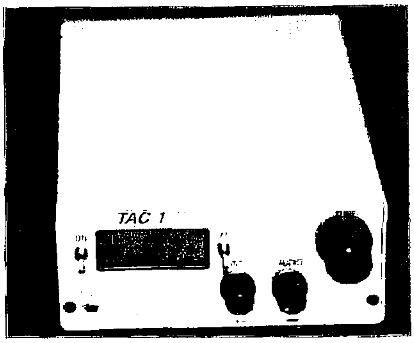
The KC1 is a respectable memory keyer, but lacks the dazzling array of keying features (like automatic sequencing of serial numbers) found in the Logikeyer III. The KC1 does include side-tone, weight control and multiple memory partitions. Keyer memories are stored in non-volatile memory; however, memories do not have separate buttons for each partition. For example, to access memory partition number three, the user presses the keyer button three times.

Mounting the KC1 is very easy, because the momentary switches used to operate the keyer also serve to mount the unit directly behind the front panel, or beneath the top cover of your transceiver. The keyer can also be mounted internally at a remote location.

Oldies But Goodies

This article would not be complete without mentioning a number of the great "classic" kits:

WM-1 Wattmeter, by Oak Hills Research. QRP with power ranges of 10 watts, 1 watt and 100 milliwatts.



TAC 1.

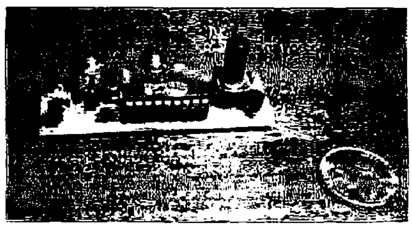
Explorer, by Oak Hills Research. Single-band superhet CW transceiver kit for 20, 30, or 40 meters. Features RIT, AGC and full QSK. 2-3 watts output. The kit comes with a punched and screened enclosure, jacks and knob set, pre-wound pre-tinned toroids, and silk-screened printed circuit board. Excellent transceiver for beginners.

PC1 Digital Frequency Counter, by S&S Engineering. LED display frequency counter with handsome extruded aluminum cabinet. Excellent frequency readout companion for home-brew QRP rigs, and a versatile piece of test equipment for your test bench.

Logikeyer III, by Idiom Press. The latest memory keyer in the Logikeyer series, the Logikeyer III now features six memory locations and non-volatile storage memory in EPROM. The postage stamp sized Logikeyer III has a robust array of superlative keying features and options such as automatic sequencing of serial numbers for contests.

I hope this article encourages you to build your first amateur radio kit, or to upgrade to build a new kit. Discover the joy of making a contact or working a new DXCC country on a radio that you built yourself. Happy building!

Very special thanks to my kit-building partner, Paul Stroud AA4XX, who built the TAC-1 and the NorCal-40A and who helped me troubleshoot the Cascade. Ernie AD4VA assisted me with the on-air testing of each of the radios.



KC1.

Getting Started: Tips for the Beginner

If this is your first kit, take a moment to prepare before building the kit. Before you open your first parts package, you may want to purchase a plastic compartmentalized parts box, which can be very handy for sorting and inventorying components. I found some nice boxes at a local housewares/kitchen supply store. Alternatively, Radio Shack™ has a suitable component box that costs a bit more (#64-552).

Read through the documentation very carefully *twice*, paying special attention to the information provided on component value data.

With every kit that I have built, there are at least a couple of components whose markings are hard to figure out. However, what seems complex when you first open the kit can be simplified by sorting out the parts, and checking off the items on the parts list supplied with the kit. When you've checked off all of the clearly marked items, you'll probably be left with only one or two confusing components, and it will be much easier to figure out which is which.

If you do not already own a soldering iron, I recommend a low wattage iron, (such as the Radio Shack™ #64-2067, a 30 watt pencil) with an extra fine pointed tip. This will be plenty of heat for fine printed circuit work.

I also recommend purchaseing a good soldering iron stand (such as the Radio Shack™ #64-2078) with a sponge tray. Using a good stand is an important safety consideration, and keeping the iron clean is one of the tricks to successful soldering. After every few solder joints, wipe the hot iron across the wet sponge to keep the tip clean.

Finally, you will probably need a good solder sucker (such as the Radio Shack™ #64-2098A). I have never completed a kit without soldering at least one component in the wrong place. The solder sucker will enable you to remove components with minimum wear and tear on the printed circuit board.

Answers to Some Frequently Asked Questions:

•*Can trim capacitors go in the wrong way?* No. Resistors and ceramic disk capacitors can't be put in the wrong way either.

•*Can electrolytic capacitors go in the wrong way?* Yes. Electrolytic capacitors have a positive and a negative side. The negative lead is shorter and is marked with a stripe and a "minus" mark. The positive lead is longer, and may have a small "+" sign, or may be unmarked. Tantalum capacitors also have a positive and negative polarity, with positive marked by a "+" sign.

•*Can integrated circuits go in the wrong way?* Yes. When you put in the ICs, be certain to match up the dot or notch on the IC with the dot or notch on the layout diagram. You may also notice that each of the sockets has a notch. Align the notch so that it is oriented with the dots.

•*How are crystals installed?* Crystals can go in the circuit in any arrangement, and they do not have a positive/negative polarity. It's helpful for crystals to be installed approximately 1/8-inch above the circuit board so that the crystals do not break if the printed circuit board is subjected to mild shock or vibration.

•*How are the diodes mounted?* For diodes that are lying flat on the board, match the black band of the diode with the band on the silk-screened board.

•*How is magnet wire on toroids soldered?* Theoretically, magnet wire uses a coating which is melted off during soldering. I have found, however, that the coating does not melt off completely, and that the resulting solder joint does not make a good connection in all circumstances. It is safer to carefully scrape away the coating with an X-acto blade prior to soldering.

Troubleshooting

If you are having any problems, remember that most problems boil down to a mistake in wiring, component placement, or a solder defect. Before calling tech support, check the following:

•*Solder defects*: The most common defect in soldering is a solder bridge. This occurs when solder connects two pads that should not otherwise be connected. Solder bridges can be fair-sized globs of solder that must be removed with a solder sucker or braid, but can also be tiny threads of solder that are easily removed with an X-acto knife. Study your work under a magnifying glass and good work light, and examine it carefully for solder bridges before you apply power to your kit.

•*Wiring:* It's very easy to reverse wires in the final hookup stage of your kit. Carefully check through all of your wiring for defects.

•*Components*: Carefully check your component placement and polarity one by one. Remember, transistors, integrated circuits, electrolytic capacitors and diodes have to be installed with the right orientation.

•*Lead Lengths*: Check to make sure that component lead lengths and wires are as short as possible.

•*Noise in the receiver*: Change the power supply or use a battery to see if the noise disappears.

•*Dead receiver:* Before you align your kit (usually peaking up a series of inductors and capacitors) it's not at all unusual for the kit's receiver to sound completely deaf. Patiently go through the alignment procedures to peak up your receiver before you decide that your receiver isn't functioning properly.

If you have double-checked all of the above items, it may be time to call the kit supplier. When you call, be sure to have a carefully prepared list of questions handy so that your tech support call is as efficient as possible.

You might also be able to get help from an experienced kit builder in your local radio club. If all else fails, most of the companies will troubleshoot and align your radio for a set fee.

Good luck!

73's DX Dynasty Award

Number 26 on your Feedback card

This is the current list of DXDA award winners. The DX Dynasty Award is the most enjoyable DX award around. Any correspondence concerning DXDA should be addressed to DXDA, c/o 73 Magazine, 70 Route 202 N, Peterborough NH 03458.

BASIC AWARD— 100 COUNTRIES WORKED

1. W1RFW
2. WB2DIN
3. KT1A
4. W3FDU
5. KA9JOL
6. WB1BVQ
7. NW7O
8. AK4H
9. W3HCW
10. KZ2W
11. K9FD
12. WD5N
13. KA9TNZ
14. K9GBN
15. N5GAP
16. WB3FMA
17. NN6E
18. AL7HG
19. N6CGB
20. KI6AN
21. K9JPI
22. N4WF
23. K6PKO
24. KW7J
25. VE6JO
26. WA4IUV
27. W4ZFE
28. N4KMY
29. WØHBH
30. K8KJN
31. KG1V
32. K1KOB
33. KY3F
34. PY2JY
35. YB5BEE
36. YB5BEH
37. WB9SBO
38. NOAFW
39. KA9MOM
40. N3II
41. W6DPD
42. KE8GG
43. VE6VK
44. KD9RD
45. W4WJJ
46. KØHSC
47. KI6GI
48. IK1APP
49. KJ4RR
50. K8MDU
51. N1EIU
52. K1DRN
53. WD8REC
54. ZL2BLC
55. VE3EFX
56. W9MCJ
57. N6IV
58. KN8D
59. KC5YQ
60. WB6ITM
61. KA2AOT
62. K4LHH
63. VE2QO
64. KE5AT
65. W9SU
66. W3OOU
67. NR2E
68. KF5PE
69. N3FBN
70. KB4SJD
71. N3EZX
72. IK8GCS
73. WB4I
74. NG1S
75. WB7UUE
76. HK4EB
77. KØBFR
78. N7GMT(KF7SH)
79. AA4VN
80. KA1LMR
81. N8AXA
82. NM2I
83. KD9YB
84. HC2CG
85. VE1BXI
86. YC2OK
87. NRGNL
88. GM3UBF
89. 5Z4BP
90. IOAOF
91. VE1BN
92. KA2NRR
93. 5Z4DU
94. KB8ZM
95. HK4CCW
96. W2JQ
97. HC2AGT
98. WD5N/M
99. VE1BHR
100. VE1AGZ
101. K5AOB
102. KW2D
103. PY3ARZ
104. WB4ETD
105. N2FPB
106. KD3CQ
107. K4NNK
108. VU2DNR
109. AA5BE
110. PY3OG
111. VE4ACF
112. VE4SI
113. PJ2KI
114. WB4CKY
115. W6EQB
116. KK4IY
117. IK1IYU
118. N6GCN
119. KB1AF
120. KB8BHE
121. KE2CG
122. VS6CT
123. G3IZQ/W
124. WB6FNI
125. KAØIAR
126. K9SM
127. W6BCQ
128. KA5MSL
129. WB4FLB
130. N7GLT
131. WAØX
132. KF4GW
133. N4QGH
134. VE1CBK
135. 7J1AAL
136. K6ICS
137. NZ7W
138. WBØN
139. WC7F
140. F6IFE
141. KL7N
142. KE8LM
143. WA6YOO
144. VE2MFD
145. N3APQ
146. HK1DBO
147. NM3V
148. IK6GFY
149. WB6UAN/M
150. NK6Z
151. KB6IUA
152. W9OKH
153. WB5FXT
154. NB3E
155. N2ESP
156. YU2EJU
157. OZ1DXX
158. IK5IIU
159. KA1ION
160. KD3AI
161. OK1AEH
162. W9LCR
163. 8P6SH
164. KA6SPQ
165. ZF2KH
166. W6MVV
167. JA8CAQ
168. KI6WF
169. K2MRB
170. AA6GM
171. JAØSU
172. NU8Z
173. GØGRK
174. YB8VM
175. DV1BRM
176. WØTU
177. N7CNH
178. PY3IO
179. YBØZCA
180. YBØAF
181. VE3PQB
182. W2SV
183. N1ADE
184. WP4AFA
185. KS7V
186. W2OFB
187. G4ASL
188. N5JUW
189. KA8WAS
190. 5NØWRE
191. AA4IP
192. JR5KDR
193. KD2WQ
194. KA3NIL
195. WA8YWK
196. VE1ACK
197. HP2XVB
198. WB5KYK
199. N5JUJ
200. N4OBJ
201. 9Q5NW
202. KW2D
203. VE1HA
204. HP8BSZ
205. IK8JJQ
206. YC3DKN
207. I3VKW
208. K2EWA
209. KD3CR
210. N9GDG
211. KF8K
212. FD1BEG
213. DU1DZA
214. N8IMZ
215. KK4YA
216. LU1JDL
217. KA8YYZ
218. KA4TMJ
219. WA9DDC
220. YI1CIS
221. YC3FNL
222. GØFWG
223. KV4B
224. N5IET
225. WA9WIG
226. N3CDA
227. KE6KT
228. IK7DBB
229. JY5EC
230. N1ETT
231. PY2DBU
232. I8IYW
233. NØISL
234. KC4BEB
235. WA7QQI
236. KA1RJG
237. OZ9BX
238. KB4HBH
239. KA3RWP
240. NJ1T
241. W4DCG
242. YCØRX
243. VE7OJ
244. AA4W
245. N9GMM
246. KB4HBH
247. KM4HF
248. CE1YI
249. KA1FVY
250. N2GVB
251. N2DAO
252. WF8E
253. YBØHZL
254. N5MBD
255. N4SNS
256. KA3TGY
257. JN3XLY
258. N4DUV
259. KA9MRU
260. KA4OTB
261. N4JED
262. AB4KA
263. WA7OET
264. KA3RVH
265. CE7ZK
266. NI9J
267. WB9PTN
268. KB8DAE
269. WØCL
270. WB7VUB
271. JF6TUU
272. ZY3IO
273. KB4VIR
274. OE6CLD
275. N7JJQ/ DU3
276. KK4FB
277. DU1AUJ
278. K2EWB
279. NI5D
280. N2JXC
281. NØIWT
282. WB3BDH
283. K1CVF
284. KA3CXG
285. KA1SPO
286. WA4NWT
287. KJ4OI
288. KA3UNQ
289. WB2VMV
290. KD4MM
291. OE3DHS
292. KD9HT
293. DL8OBC
294. G3KVA
295. WA4NEL
296. KA4VZO
297. NØIDT
298. KA1FUE
299. KD7EO
300. JH8MWW
301. KB8ICD
302. JA1CKE
303. N3GEE
304. JA5MG
305. KA1FTU
306. WA8KMK
307. N2IBW
308. N4THE
309. N3CYD
310. JA4TF
311. W6YLL
312. WA1S
313. KC5WA
314. N6WK
315. PY4OY
316. KG7BO
317. WB3FQY
318. WCØA
319. VE4AMU
320. YCØMCA
321. WA3LEU
322. KB2GLO
323. OZ1FNX
324. K6GCF
325. KC4PCX
326. KA7EXD
327. DK9EA
328. HL5AP
329. SM7BRO
330. ON6DP
331. WA3KKO
332. KB9ABI
333. DA2UI
334. SMØBNK
335. WA2BMQ
336. WAØQIT
337. 5Z4BH
338. KB9ALG

339. OA4ANR
340. OD5ZZ
341. VE3ZD
342. LU2ATR
343. HL5FRG
344. UB5LRS
345. N1ICC
346. UY5XE
347. PS7AB
348. IK4NPC
349. KD1CT
350. DU1CHD
351. UB4WZA
352. LU3CF
353. G7AZP
354. VE5AAD
355. IK3ITX
356. SM4SEF
357. N9CPK
358. VE2JWK
359. N7JXS
360. KO4VO
361. JE1GWO
362. JM2DRM
363. IK1SLE
364. JF7QUE
365. HL5BUV
366. VE3GLX
367. N7QXQ
368. JE6KLR
369. KK6JY
370. N2BI
371. KK4XL
372. JA3SSB
373. KBØADI
374. I7-50156
375. VU2SMN
376. EA6AAK
377. N3IHS
378. N8MOT
379. KB2NEK
380. PY2DBU
381. WA2CKP
382. WB2PPN
383. JA1-2Ø762/BV
384. AB4ZD
385. YC8EMH
386. WA8RLB
387. N5VWM
388. VE7SKB
389. KB4BCC
390. VE7GSE
391. YC8BWN
392. KN6ER
393. KD1CJ
394. G2BFO
395. KB7ROK
396. VK2EQ
397. 4X4-2175
398. JE1BGL
399. KF2LC
400. WV2X
401. LU5EWO
402. WAØCLR
403. VO1UL
404. VE6AML
405. WD4REX
406. WAØCLR
407. VE3VJC
408. WA1MKS
409. JH6FHJ
410. JE9EMA
411. WK8X
412. TI2YLL
413. KP4WN
414. KD6MOS

150 COUNTRIES ENDORSEMENT

1. WB2DIN
2. N4WF
3. N6GCB
4. K9FD
5. NØAFW
6. N3II
7. WB1BVQ
8. KA2AOT
9. KI6G1
10. N7GMT
11. IK8GCS
12. IK1APP
13. VE6JO
14. VE4ACF
15. WB4I
16. IK1IYU
17. KE2CG
18. G3IZQ/W1
19. WB6FNI
20. K8MDU
21. VE6VK
22. KB6IUA
23. WB5FXT
24. YU2EJU
25. IK5IIU
26. KE8LM
27. KA1ION
28. KA6SPQ
29. W6MVV
30. JA8CAQ
31. KI6WF
32. JAØSU
33. WD5N
34. W2SV
35. W6BCQ
36. F6IFE
37. VE2MFD
38. WP4AFA
39. 5NØWRE
40. KD2WQ
41. VE1ACK
42. N5JUJ
43. 9Q5NW
44. KB8BHE
45. I3VKW
46. KD3CR
47. N8IMZ
48. GØFWG
49. N2FPB
50. KE6KT
51. OZ9BX
52. NJ1T
53. CE1YI
54. YBØHZL
55. JN3XLY
56. KA9MRU
57. CE7ZK
58. KB8DAE
59. K2EWB
60. NI5D
61. KD3CQ
62. KA4OTB
63. WB2VMV
64. KD4MM
65. KD9HT
66. KA3NIL
67. NØ1DT
68. KA1TFU
69. KA4TMJ
70. JA4TF
71. KA3UNQ
72. KB8ZM
73. K2EWA
74. WA1S
75. PY4OY
76. WCØA
77. OZ1FNX
78. KA7EXD
79. ON6DP
80. VE1RJ
90. N6WK
91. WA3KKO
92. KB9ABI
93. SMØBNK
94. WAØQIT
95. 5Z4BH
96. OA4ANR
97. OD5ZZ
98. VE3ZD
99. HL5FRG
100. UB5LRS
101. PS7AB
102. KD1CT
103. DU1CHD
105. IK3ITX
106. VE2JWK
107. N7JXS
108. JM2PRM
109. HL5BUV
110. VE3GLX
111. KK6JY
112. EA6AAK
113. N3IHS
114. WA2CKP
115. VE6AML
116. WAØCLR
117. WA1MKS
118. KD6MOS
119. KP4WN
120. LU5EWO

200 COUNTRIES ENDORSEMENT

1. N3II
2. WB2DIN
3. K9FD
4. IK8GCS
5. NØAFW
6. WB1BVQ
7. VE4ACF
8. KI6GI
9. N6GCB
10. K8MDU
11. YU2EJU
12. KE8LM
13. WD5N
14. F6IFE
15. 5NØWRE
16. KE2CG
17. I3VKW
18. CE1YI
19. W6BCQ
20. CE7ZK
21. KB8DAE
22. K2EWB
23. KD3CQ
24. KD4MM
25. KD9HT
26. KA4TMJ
27. N7GMT
28. JA4TF
29. K2EWA
30. WA1S
31. PY4ØY
32. ON6DP
33. VE1RJ
34. WA3KKO
35. WAØQIT
36. 5Z4BH
37. HL5FRG
38. JAI-2Ø762/BV
39. VE6AML
40. LU5EWO

250 COUNTRIES ENDORSEMENT

1. WB2DIN
2. IK8GCS
3. WD5N
4. K8MDU
5. KE2CG
6. CE1YI
7. CE7ZK
8. K2EWB
9. KD9HT
10. N7GMT
11. KD3CQ
12. KB8DAE
13. WA1S
14. PY4OY
15. VE1RJ
16. 5Z4BH
17. N2BI
18. I75O156
19. VE6AML
20. KB8ZM
21. LU5EWO

300 COUNTRIES ENDORSEMENT

1. WB2DIN
2. IK8GCS
3. K2EWB
4. K8MDU
5. N7GMT
6. WA1S
7. PY4OY
8. KD3CQ
9. VE1RJ
10. UY5XE
11. IK3ITX
12. VU2SMN

350 COUNTRIES ENDORSEMENT

1. WB2DIN
2. PY4OY
3. UB4WZA

NEVER SAY DIE

Continued from page 8

room? I forget how many hundreds of billions of dollars the whole thing was estimated to cost.

My question resulted in more obfuscation, and a shift to an even higher level of encrypted language. After my asking my question about four times I finally got a grudging yes, that's about what it all adds up to. I told the colonel he and the Air Force master minds who thought up this one were crazy. I suggested they use technology instead of brute force to solve their problems, and that if they insisted on pursuing this I'd raise all the hell I could, and do my best to embarrass them for such a stupid and expensive idea.

Well, it never happened, though I don't know if my grain of sand's worth of resistance had any part in their abandoning the project. Anyway, we didn't lose 450 MHz back in 1956.

While I was there they introduced me around. One of the chaps I met was in charge of assigning berths to the media on Navy ships. I said, hmm, what have you got open? Well, they had a supply ship going to Antarctica with an opening. I told 'em to hold it for me. It was a three-month trip, so I didn't have the time to go, much as I'd have liked to. But I thought I might be able to talk Jim Morrissett K2OLK, who'd been my assistant editor for a couple of years, into making the trip on assignment. I asked what the possibility was of my reporter taking along a ham station to use on the ship. No problem, except I'd have to get permission from the captain of the ship.

Sure enough, Jim liked the idea, so I sent him a Retina IIIc 35mm camera for the photos and arranged for a Hallicrafters transmitter and receiver for the ship. Then I set about getting permission from the ship's captain. He said he had no objection, but of course I'd have to get it okayed by the Navy Chief of Communications, Admiral Bruton. The Admiral nixed the ham station, for no reason I could see, and he flatly refused to discuss the matter.

So I wrote an editorial explaining exactly what had happened. And, since I had my editorial work done a few weeks ahead of schedule, I took off for a scuba diving trip to Acapulco. Well, there was this fantastically beautiful British girl I'd met in Bermuda who was also into diving, and who was working for a dive shop there. But that's another story. The diving was great and I got some spectacular pictures.

But when I got back to the US I found myself in Great Big Trouble. It seems that my assistant editor, Art Brothers W7NVY, thought my editorial didn't have quite enough zing to it, so he edited it a bit. The word "traitor" was added and Admiral Bruton was not amused. The publisher, Art, and I were soon facing

Continued on page 43

Number 30 on your Feedback card

Simple Secondary Frequency Standard

Stay within your legal frequency.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30
Salinas PR 00751-0030

Every ham is required by the FCC to make certain his or her transmitted signals are entirely within the band or subband appropriate to the license class. Operating outside assigned frequency band segments invites "Pink Slips" from the FCC, requiring explanation as to why the offense occurred and what means are being used to prevent it happening in the future. Continued off-frequency operation can result in fines, possible jail time, and even cancellation of your license. Because of this, most hams have either expensive, fancy commercial transceivers with digital frequency readout controlled by a crystal, or they build and use a secondary frequency standard, commonly called a "crystal marker generator." It is for hams whose budgets don't include a thousand dollars or more for a fancy commercial transceiver loaded with bells and whistles that this article is presented.

There are a number of marker generator circuits presented in the ham magazines as well as in the *ARRL Handbook*. Most, however, specify the use of a crystal at 100 kHz or 1 MHz. A glance at the listing of crystals for sale in any mail order parts dealer's catalog will show that crystals of these frequencies are rather expensive. It is possible (and very simple) to build a marker generator based on a much higher crystal frequency, *plus* it has advantages in long-term stability over the lower frequency crystals usually specified. It also saves money, because surplus microprocessor crystals usually cost only about $1.00.

Every crystal, regardless of cost, is subject to "aging" which results in a change in frequency, although some crystals are far more stable over time than others. Hams are interested primarily in 100 kHz and 25 kHz marker frequencies because these accurately mark the edges of most bands and subbands. A low-frequency crystal drifting off frequency causes these markers to drift, too, which could result in out-of-band operation, with the unfortunate consequences mentioned in the first paragraph. However, a crystal of a frequency of 10 MHz which also drifts a bit will not cause the same amount of error as the low-frequency crystal, because its frequency, and drift, is divided by a factor of 100 at 100 kHz, and 400 at 25 kHz. In "real life," after the 10-MHz crystal has been adjusted to exactly 10 MHz, either by using a frequency counter or by zero beating the crystal with the signal from WWV, any drift in crystal frequency due to aging will be so minute after being divided down to the desired 100 kHz or 25 kHz that it cannot be heard. For all practical purposes, the divided marker frequencies will remain accurate over time.

"This marker generator provides accurate marker RF signals at 1 MHz, 100 kHz, 50 kHz, 25 kHz, and 10 kHz when the crystal oscillator is zero beat with WWV or otherwise set to exactly 10 MHz."

The secondary frequency standard—the crystal marker generator described here—is based upon the use of a 10-MHz surplus microprocessor crystal as its standard. It is called a "secondary" standard because it is set to frequency with a frequency counter or by zero beat with the carrier transmitted by WWV. Primary Standards are those maintained by the National Bureau of Standards, which are very precise and very expensive, and serve, among other things, to establish the carrier frequency of WWV and WWVH.

This marker generator provides accurate marker RF signals at 1 MHz, 100 kHz, 50 kHz, 25 kHz, and 10 kHz when the crystal oscillator is zero beat with WWV or otherwise set to exactly 10 MHz. It uses the fewest, most common, inexpensive, and readily available components: one crystal, one 5-volt regulator, five TTL logic ICs (commonly called "chips"), three 1/4-watt resistors, two disc ceramic capacitors, one small trimmer capacitor, one ON-OFF switch, one 9-volt battery, and one single-pole five-position wafer switch. The total cost, using all new "surplus" parts, will be less than $10.00. This is very inexpensive insurance to make certain all your transmissions are on legal frequencies!

Circuit Description

Fig. 1 is the schematic diagram of this instrument. Refer to this illustration for the following discussion. Battery B1 (9 V) provides power through S1 to a 5-volt regulator, U6, a 78L05, which provides regulated +5 VDC to the five ICs—chips—which provide all the marker frequencies from 1 MHz down to 10 kHz.

U1, a 74LS00, is a quad two-input NAND Gate. Two of its sections, U1a and U1b, are connected to form an oscillator circuit controlled by the 10 MHz crystal, Y1, which is adjusted to frequency by trimmer capacitor C2. The remaining two sections are connected to form inverters and provide the output signal of 10 MHz at pin 11.

The 10-MHz output from U1 is applied to the pin 1 input of U2. U2, a 74LS90, is a divider connected to divide by 10. U2 divides this 10 MHz to 1 MHz and provides its output at pin 12. This 1 MHz signal is routed to the first position terminal of S2, and also to the pin 1 input to U3.

U3 is a 74LS90 divider also connected to divide by 10. It divides the 1-MHz input to 100 kHz and provides its output at pin 12. This 100-kHz signal is routed to the second position terminal on S2, and also to the pin 11 input of U4.

U4 is a 74LS74, a dual flip-flop configured to divide by both two and four, producing 50 kHz at pins 3 and 9, and 25 kHz at pin 5. The 50 kHz from pins 3 and 9 is routed to the third position terminal of S2, and also to the pin 1 input of U5. The 25-kHz output from pin 5 of U4 is routed only to the fourth position terminal of S2. U5 is a 74LS90 configured to divide by five. It divides the 50-kHz input and produces a 10 kHz signal at pin 11. This 10 kHz signal is routed to the fifth position terminal of S2.

C3 connects from the wiper terminal of S2 to the output connector of the builder's choice. C3 also serves to block the DC voltages of the divider chips from appearing at the output.

Construction

This unit may be constructed on a piece of perfboard, or one of the general purpose printed circuit boards available from Radio Shack. It could also be constructed "dead bug" style by gluing the chips upside down on a piece of circuit board stock, perfboard, plastic, even wood. Lead lengths should be kept reasonably short, especially around U1. Other leads are not critical; just use common sense.

Caution: Pinouts of all chips and the 78LO5 regulator are illustrated in Fig. 1. Pinouts of all chips are shown from the top of the chip. Pinout of the regulator is shown from the bottom. Make certain you are connecting to the specified pins!

If you use perfboard or a printed circuit board you may install 14-pin DIP sockets and do all your wiring before plugging the chips into the sockets. Sockets are not necessary but you may use them if you wish.

In soldering to the pins on the sockets or chips, and to the pads on a printed circuit board, be extremely careful, not only to make solid, shiny solder joints, but to avoid "solder bridges," which occur when too much solder is applied, accidentally bridging two adjacent pads or pins. Use a 25- or 30-watt soldering pencil with a small tip, and always use rosin core solder, preferably marked "60-40" or "63-37," indicating the tin and lead proportions in the solder.

Warning! Never use acid core solder in electronics: It will corrode the connections and ruin anything built with it.

Before applying power, carefully inspect every connection, every solder joint. Correct any poor solder joints and eliminate any solder bridges. If you use DIP sockets, be absolutely certain the chips are inserted in the proper locations and in the proper heading—pin 1 on the chip to pin 1 on the socket. It will be helpful if you mark (with a dot of white paint, perhaps) the position of pin 1 on top of each chip, and also on the corner of each socket.

Because this marker generator is a digital circuit, it will either function perfectly or not at all. If it doesn't work you have made a wiring error, or you have plugged a chip into the wrong socket. Go back and check *everything* against the schematic diagram in Fig. 1.

Calibration

If you own, or can borrow, a frequency counter that you know is accurate, use it with a probe to measure the frequency at pin 11 of U1. Using an insulated screwdriver which fits the slot in C2, slowly adjust C2 for a frequency of 10.000000 indicated on the frequency counter. Then also check the frequency at each marker output from S2. You should find 1.000000, 0.100, 0.050, 0.025, and 0.010 indicated on the counter. If any output frequency is missing or in error, you have made an error during construction, which you will have to find and correct.

You can also zero beat this unit against the carrier of WWV. Usually, 10 MHz is the most likely frequency where WWV can be heard throughout the USA, Canada, and northern Mexico. Elsewhere in the world WWV also transmits on 2.5, 5.0, 10.0 and 15.0 MHz. Any frequency where WWV can be heard clearly can be used for calibration.

With a receiver tuned to WWV, and S1 on the marker generator in the ON position, either place the marker generator close to the receiver, or connect, with a piece of wire a couple of feet long, the receiver antenna connector to the whip antenna if you are using a typical "world band" portable radio. With an insulated screwdriver, adjust C2 as described above until you hear the squeal of the marker crystal beating against WWV. Adjust C2 until the signals are in zero beat or very close. Besides the time ticks at one-second intervals there is a 600-Hz tone transmitted most of each minute. The time in Coordinated Universal Time (UTC) is announced by a male voice (USA) or female voice (WWVH

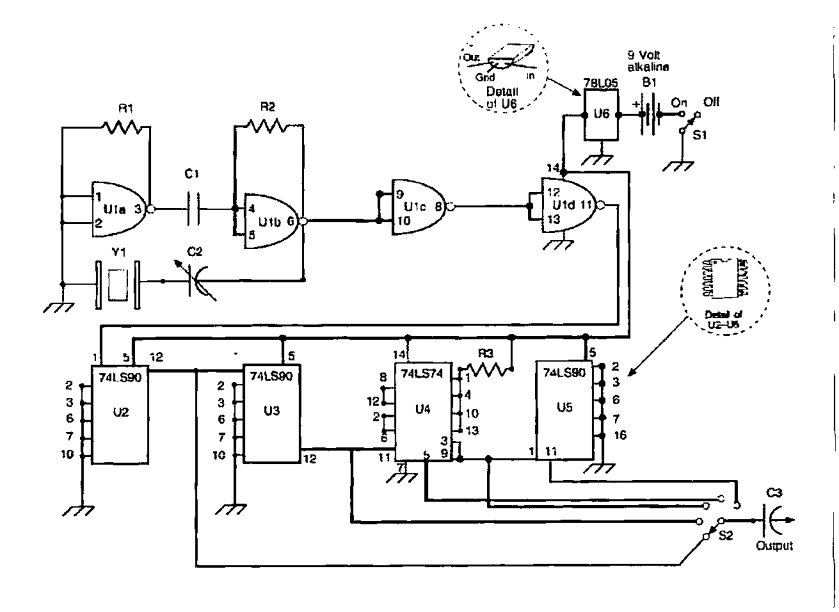


Fig. 1. Schematic for the simple secondary frequency standard.

Hawaii) at the end of each minute. Forty-five seconds after the voice announcement begins a silent (except for time ticks) period 7-1/2 seconds long. For greatest accuracy of calibration, adjust C2 to as close to a perfect zero beat with WWV's carrier as possible. This period should be long enough if you were close to zero beat earlier, but if necessary you can wait one or two minutes and recheck zero beat until you are satisfied it is the closest you can come.

Caution: Be certain the screwdriver you use to adjust C2 is non-metallic. C2 has both terminals floating and is a critical component in the oscillator. Using a metal screwdriver tip will make it impossible (due to "hand capacitance") to get to an accurate zero beat.

Now check the marker frequency at each position of S2 by tuning the receiver carefully and checking against its dial. Unless the receiver dial has a digital readout it will probably not be exactly accurate, but will be close enough that you can tell if the desired marker frequency is missing or if it is far off frequency. Either result indicates an error in construction which you will have to locate and correct.

This completes calibration of your secondary frequency standard. It can be used and totally trusted for years, although a recheck of the crystal frequency as described above should be made after six months, and then once every year from then on. A slight adjustment of C2 may be required to put the crystal frequency back "on the nose."

Operation

As mentioned earlier, this instrument either works perfectly or it doesn't work at all. If you have followed directions, it will work each time you turn it on. The output level from the marker generator is fairly high, S-9 or better if fed directly into the antenna connector of your receiver. Often it will be preferable to add a few feet of wire to the output of the marker generator and allow it to radiate its signals to your station receiver. This is the preferred method if you are using it to pinpoint the edge of the band or subband you intend to operate on. However, it has many other uses, discussed below.

Hams who build their own transmitters and receivers need to be able to calibrate their analog dials. Too, if your receiver does not have a digital readout, you will need to use the marker generator to locate specific frequencies—that is, within 10 kHz because the lowest frequency markers are 10 kHz apart.

Calibrating a Receiver Dial

To begin, you'll need a known frequency. The simplest way of determining this is to tune the receiver to around where you think the low edge of the ham band should be. Note the activity on the band. At the lower edge of this activity—1.8, 3.5, 7.0, 14.0, 21.0 or 28.0 MHz—turn on the marker generator and set S2 to 1 MHz. Tune the receiver for zero beat—it is assumed either a BFO or product detector is included in the receiver. Mark the dial with the proper band edge frequency. Then, selecting other frequencies with S2 you can locate and mark frequencies within the band, even down to every 10 kHz if desired.

A slightly more complicated way of locating known frequencies is to build a small crystal oscillator using a color-burst crystal whose nominal frequency as marked is 3.579545 MHz. Duplicate the U1 portion of the schematic diagram, Fig. 1, remembering to supply +5 VDC to the 74LS00 chip. Do not include C2, but connect the crystal directly between pins 1-2 and 6. This crystal will produce frequencies either within or very close to every HF ham band between 80 and 10 meters, including WARC bands. However, you will have to check the crystal fundamental frequency with a frequency counter because it *will not* be exactly 3.579545 MHz. When the fundamental frequency is accurately known, use a calculator to multiply the fundamental frequency and note the frequency of each harmonic. Keep a copy of these known frequencies for future reference. Because the harmonics of this oscillator are more than 3.5 MHz apart it is easy to locate the desired known frequency. With this as a starting point, and using the required output selected by S2, you can easily locate WARC bands as well as calibrating these and other HF bands.

Calibrating a VFO Dial

A calibrated receiver with a digital readout can be used easily to calibrate a VFO dial without use of the marker generator. Merely tune the receiver to the desired frequency and zero beat the VFO to the receiver. Then mark this frequency on the VFO dial, repeating as desired. If your receiver has an analog dial and you have calibrated it with the marker generator, you can tune the receiver to the desired frequency as described in the preceding paragraph, repeating this procedure as necessary. If the receiver you are using has an analog dial, such as a portable shortwave receiver that covers the ham band frequencies, you can locate the lower band edge by setting S2 at 1 MHz and tuning the receiver slowly while looking at the receiver dial closely until you achieve zero beat. Dial scales on these receivers are inaccurate but usually not so far off that the proper 1-MHz signal cannot be located accurately. It is assumed the receiver contains a BFO or product detector and is capable of receiving SSB and CW. If this is not the case it is not recommended that this receiver be used. While it is possible to locate—approximately—the 1-MHz signal by a peak in the level of the rushing noise from the receiver, this is not precise enough to be trusted. You'll have to either borrow a suitable receiver or take your VFO to a local ham who does have a usable receiver.

Conclusion

Although this crystal marker generator produces usable harmonics at frequencies well above and below the MF and HF ham bands, it is intended for hams operating from 160 through 10 meters. ("Lowfers," unlicensed but legal operators in the 160-190 kHz band, can also use this unit to calibrate the receivers and VFOs of their 1-watt stations.) Because it covers such a broad frequency spectrum with signals of known frequency, spacing and accuracy, the marker generator can take the place of a less accurate signal generator in general radio servicing, including calibration checking and alignment. Despite its many other possible uses, it is presented here primarily as a useful aid to prevent accidental operation on frequencies not available to your license class. 73

Parts List

B1	9-volt alkaline battery
C1	0.01-µF disc ceramic capacitor
C2	5-60-pF trimcap, Murata etc.
C3	47-pF disc ceramic capacitor
R1, R2	560-ohm watt 5% resistor
R3	1k-ohm watt 5% resistor
S1	SPST toggle or slide switch
S2	1-pole 5-position wafer switch
U1	74LS00 quad 2-input NAND Gate
U2, U3, U5	74LS90 Decade Counter
U4	74LS74 Dual-D Flip-Flop
U6	78LØ5 5-volt regulator
Y1	10.000000-MHz microprocessor crystal

NOTE: The output connector suggested in Fig. 1 can be a binding post, RCA jack, or any other type connector you wish to use.

The Tiny Tic-Tac Tester

This useful and easy-to-build tester is a good first-time project.

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It is often useful to be able to check the voltage of your batteries. For instance, you may wonder if your handie-talkie is charged or not. Unfortunately, most batteries, especially rechargeable batteries, do not change voltage much between being fully charged and nearly discharged, so a very accurate meter is needed. Good digital multimeters will work well, but they are expensive and bulky. The tiny Tic-Tac tester is an alternative that is very small (you can carry it in your shirt pocket), inexpensive and quite accurate. The tester doesn't require batteries to work since it takes the little power it needs from the source it is testing! Photo A shows one I built in a Tic-Tac container, hence the name. As you can see, it is small—about 1-1/2" x 2" x 1/2" thick. An experienced builder could put it in an even smaller case.

How It Works

Fig. 1 shows the schematic of the tester. The only parts used are one IC, 10 LEDs for display, four fixed resistors and one potentiometer. If you use the available (from me) PC board you will probably spend more time putting the project in an enclosure than you will soldering it together!

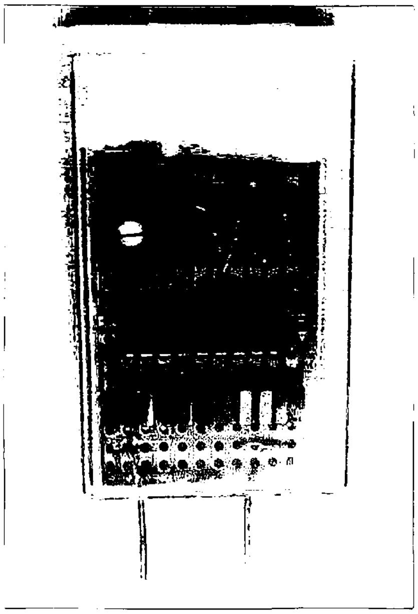

Photo A. The tiny Tic-Tac tester.

The heart of the tester is an IC called the LM3914 which contains 10 voltage comparators connected to a 10-step resistive divider and an on-board voltage reference. The comparators on the chip work like any standard comparator. When the voltage on the minus pin is greater than the voltage on the plus pin, the output of the comparator goes to ground and lets current flow through the comparator output port. When the minus pin voltage is less than the plus pin voltage, the comparator output floats and no current can flow to ground. The internal comparators are used to turn on the display LEDs. As the signal voltage increases, more LEDs will turn on. What values of signal voltage will turn on the LEDs depends on the "control voltage" at the positive terminal of each comparator. By setting a reference voltage across the internal voltage divider of the LM3914, the comparators can be made to turn on in 10 equal steps of one-tenth the voltage across the divider. The LM3914 makes it easy to set any desired voltage across the divider.

The voltage to be measured, which powers the chip, goes to pins 2 and 3 of the LM3914 (see Fig. 1). A voltage divider, formed by R4 and R5, reduces the voltage by half and applies it to pin 5, the buffered signal input pin. It is important to use this divider because the voltage to be measured must be at least 1.5 volts *less than* the voltage powering the chip.

R3 is connected between pin 7 and pin 8, which is the on-board reference voltage. Since the reference voltage is known and so is R3, a known current is

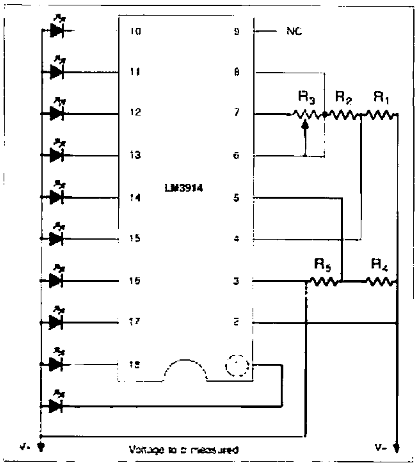

Fig. 1. Shows the schematic of the Tic Tac Tester. It's easy to build, accurate and can be carried in your shirt pocket.

generated through R3 ($I1 = VRef \div R3$). This current (plus a small current from pin 8) flows to ground through R2 and R1. By selecting R1 and R2, any desired voltage can be set at points VLow and VHi. Connecting pins 4 and 6 to VLow and VHi gives us the desired control voltages for the comparators.

A control switch not shown in Fig. 2 lets the user program how the LEDs are turned on. If pin 9 is left floating, only one LED at a time will be turned on (called dot mode). As the voltage increases and a new LED comes on, the last LED will turn off. This mode is useful for low power use. If pin 9 is connected to pin 3, each LED will stay on (called bar mode). When the input voltage reaches the VHi value, all the LEDs will be on.

The LED display has an advantage over a digital display because it is easy to read at a glance even from a distance. By making the LEDs different colors, it is possible, for example, to display low voltage as red, OK voltage as green, and high voltage as yellow.

Building A Tiny Tester

What follows is somewhat technical; if you are not interested in how I got my

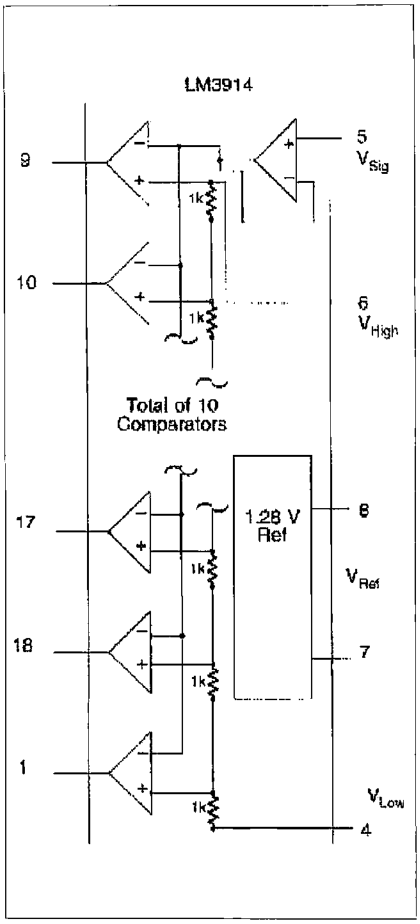

Fig. 2. A look inside the LM3914, the chip has a total of 10 comparators.

resistor values but only want to know what values to use for your tester, you can go directly to Table 2. Many variations of this meter can be built. I will discuss the one I built to check the voltage of my Kenwood handheld. It has nickel rechargeable batteries and the pack says it is 8.4 volts. Because "nominal" voltage for NiCds is 1.2 volts, I know it has seven cells.

A fully charged NiCd (see Fig. 3) is about 1.40 volts, and when it reaches about 1.14 volts it is pretty much discharged. For my tester, I chose:

V_{Hi} = 1.40 x 7 = 9.80 volts

I wanted the first LED to come on when the battery voltage was greater than

1.14 x 7 = 7.98 volts

As you can see from Fig. 2, the first LED will not turn on until the signal voltage is equal to V_{Low} plus one-tenth of the internal voltage divider difference. With a voltage across the divider of:

9.8 – 7.9 ≈ 2 volts

Each step is about 0.2 volts, so I set

V_{Low} = 7.98 – 0.2 = 7.8

Another design consideration was current draw. Since I was powering this meter from the batteries I was measuring, I wanted a small current draw. Obviously I chose "dot mode" rather than "bar mode." Further, the chip has built-in current limiting of the LED, which is why no resistors are needed in line with them. The current through an LED is limited to 10 times the current through R3. I decided to make LED current about 5 mA so the total current draw would be 10 mA. Although the LEDs are not as bright as if they had a full 20 mA, the LEDs I used are clearly visible in daylight. The value needed for R3 to get this current is:

R = f(V,I) = f(1.28 volts,0.5 mA) = 2560 Ω

I used a potentiometer for R3 because the accuracy of the reference voltage is only about ±5% and to measure the NiCds I needed more accuracy. The potentiometer allowed me to fine-tune I1 for more accuracy on VLow and VHi.

Since I knew I1 and the voltages I wanted at points VLow and VHi, I could determine R1 and R2:

R1 = f(1.12 Volts,0.5 mA) and R2 = f((1.4 – 1.12),0.5)

It's that easy. Well, almost that easy. In fact better accuracy is obtained by including a few other factors. The internal 10kΩ divider acts as a parallel resistor to R2 and there is also a small current from pin 8 to drive the reference voltage. Table 1 shows the actual calculations I used to include these factors and Table 2 shows values for some common battery configurations.

Note in Table 2 that, for seven cells, the 10 steps from 1.12 to 1.40 are each about 200 millivolts. This is a precision of:

f(0.200,8.00) = 2.5% ± 1.25%

This is a pretty precise device. This fact needs to be considered when building the meter. Most resistors are ±5% resistors so they have four times the error of our meter. Obviously ±1% resistors will work much better. In fact, I put together several ±5% resistors and measured their actual values to get less than 1% error.

Once you have soldered the meter together, you need to make only one calibration. Connect the battery pack you plan to measure and measure V_{Low}. Adjust R3 until V_{Low} is the desired value. That's it.

I put a couple of rather stiff wires off the edge of the PC board. By filing a small set of notches in the top of my

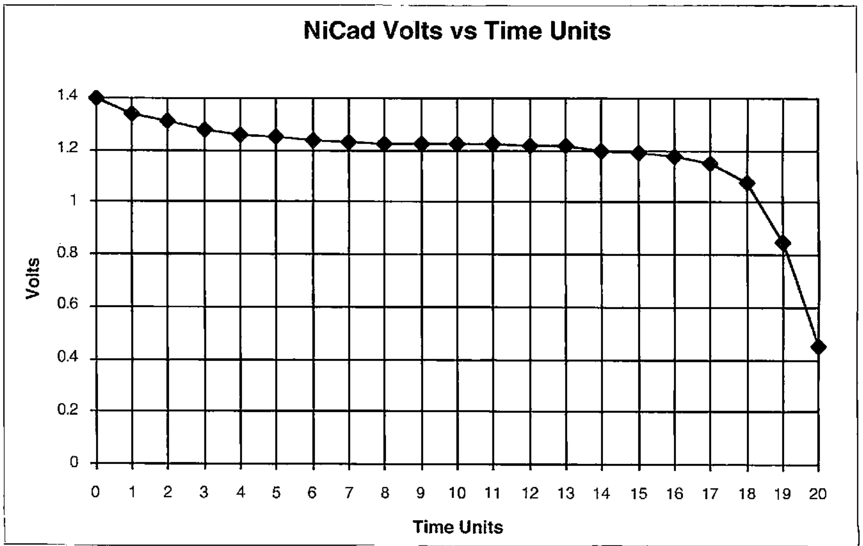

Fig. 3. Typical voltage vs. time curve for NiCd battery under load.

handheld's battery pack, I was able to insert the tester and touch the battery terminals. This makes it easy to check battery voltage.

Limitations And Constraints

Such a simple device naturally has a few limitations:

1. You need to measure at least 3 volts for the LM3914 to work.
2. Total divider voltage ($V_{Hi}-V_{Low}$) should be at least 200 mV in bar mode and 500 mV in dot mode for best results.
3. Absolute max for supply voltage is 25 volts.
4. To increase the accuracy I did not include a protection diode. Connecting a battery backward will likely destroy the LM3914. So far, I have not tested this feature!
5. The voltage to be measured at pin 5 must be at least 1.5 volts *less than* the supply voltage.

Obtaining the Parts

Parts are readily available from the usual suppliers: Mouser, MCM, JDR Micro Devices, etc. A PC board is available from me for $5. If you prefer to buy the PC board and all of the parts (except the Tic-Tac box), that'll be $15. Please specify which of the versions in Table 1 you want to build so I can send the correct 1% resistors. Prices include shipping in the US. Florida residents please add sales tax for your county *(or move to New Hampshire, where there is no sales tax...Wayne).*

Table 1 Equations to select resistors

$R_3 = f(1.28, I_1)$
$R_1 = f(V_{Low}, (I_1 + 0.075))$
$R_2' = f((V_{Hi} - V_{Low}), (I_1 + 0.075))$
R_2' is a temporary variable used to make calculating R_2 easier
$R_2 = f(R_2' \times 10, (10 - R_2'))$

I1 is in mA
R_1, R_2, R_3 are in kΩ
V_{Hi}, V_{Low} are in Volts
R2' is a temporary variable used to make calculating R2 easier.

Remember: because of the voltage divider, V_{Lo} and V_{Hi} will be half the voltage of the battery you are measuring.

Table 2
Some Component Values for Selected Battery Configurations

	Vlow*2 (see note) volts	Vhi*2 volts	LED CURRENT milliamps	R3 kohms	R1 kohms	R2 kohms	Vlow LED NUMBER	VOLTAGE 1	AT 2	WHICH 3	LED 4	TURNS 5	ON/OFF 6	(Volts) 7	8	9	Vhi 10
NICAD CELLS																	
4	4.44	5.60	5	2.560	3.86	1.12	4.4	4.6	4.7	4.8	4.9	5.0	5.1	5.3	5.4	5.5	5.6
5	5.55	7.00	5	2.560	4.83	1.44	5.6	5.7	5.8	6.0	6.1	6.3	6.4	6.6	6.7	6.9	7.0
6	6.66	8.40	5	2.560	5.79	1.78	6.7	6.8	7.0	7.2	7.4	7.5	7.7	7.9	8.1	8.2	8.4
7	7.77	9.80	5	2.560	6.76	2.14	7.8	8.0	8.2	8.4	8.6	8.8	9.0	9.2	9.4	9.6	9.8
8	8.88	11.20	5	2.560	7.72	2.53	8.9	9.1	9.3	9.6	9.8	10.0	10.3	10.5	10.7	11.0	11.2
9	9.99	12.60	5	2.560	8.69	2.94	10.0	10.3	10.5	10.8	11.0	11.3	11.6	11.8	12.1	12.3	12.6
10	11.10	14.00	5	2.560	9.65	3.37	11.1	11.4	11.7	12.0	12.3	12.6	12.8	13.1	13.4	13.7	14.0
Alkaline Cells																	
3	4.35	4.95	5	2.560	3.78	0.55	4.35	4.41	4.47	4.53	4.59	4.65	4.71	4.77	4.83	4.89	4.95
4	5.80	6.60	5	2.560	5.04	0.75	5.8	5.88	5.96	6.04	6.12	6.2	6.28	6.36	6.44	6.52	6.6
5	7.25	8.25	5	2.560	6.30	0.95	7.25	7.35	7.45	7.55	7.65	7.75	7.85	7.95	8.05	8.15	8.25
6 (9Volt battery)	8.70	9.90	5	2.560	7.57	1.17	8.7	8.82	8.94	9.06	9.18	9.3	9.42	9.54	9.66	9.78	9.9
Lead Acid 6 Cells																	
	11.80	13.00	20	0.640	2.84	0.30	11.8	11.9	12.0	12.2	12.3	12.4	12.5	12.6	12.8	12.9	13.0

NOTE: Voltages shown are actual voltages of the battery being measured. When calculating resistor values remember to account for the voltage divider of R4 and R5.
R4 = R5 = 10.0 kohms

Table 2. Some component values for selected battery configurations.

A New Look at the VXO

80 through 10 meter coverage using a TV color burst crystal.

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In my experimental endeavors with frequency generating devices I became very fond of the Pierce oscillator, not only for crystal control but as a VFO using a coil in series with a blocking capacitor in lieu of the crystal. The basic Pierce oscillator circuit is described in almost all radio handbooks, so it needs no detailed mention here. However, it is always shown as a crystal-controlled device. By using quality parts and voltage regulation, it can be used as a respectable VFO.

The Coils

I decided to experiment using a coil in series with the crystal and an adjustable ferrite core in the coil to see how much of a frequency change I could get. There is a similar circuit shown in my *ARRL Handbook*, but they use a split-stator variable capacitor for the tuning and claim a maximum swing of some 15 kHz. I was looking for a much higher frequency excursion. Years ago, I wound a series of "honeycomb" coils ranging in size from 50 turns to 450 turns. I connected the 50-turn coil in series with a TV color burst crystal (3.57945 MHz) and poked a 1/4" ferrite rod into the coil field. I was surprised to see a frequency swing of 30 to 40 kHz. I should mention at this point that my coils were wound with Litz wire. This is an important point!

I fooled around for hours winding many coils using #28 to #36 enameled wire, but could not get satisfactory performance. I finally found that a coil with 60 turns of 14/44 Litz wire did the trick; the result is shown in Fig. 2. Why the solid wire would not work is still a mystery.

The 14/44 Litz wire that I used may be hard to find, but I've noted that 10/44 Litz wire is available from LF Engineering Co., 17 Jeffry Road, East Haven CT 06512, and from Amidon Associates, Inc., 2216 Gladwick Street, Dominguez Hills CA 90220.

> ***"This circuit could be ideal for QRP transmitters and transceivers."***

The coil assembly shown in Fig. 2 should be closely followed as far as the coil, ferrite rod and 8-32 aluminum screw feed are concerned. The coil is wound between two flanges cut from cardboard and spaced 1/4" apart. The coil contains 60 turns. The coil form sleeve can be of any insulating material and should have an ID of 1/16" to 3/32" larger than the ferrite rod.

The most difficult part of the assembly is to cement the 8-32 aluminum screw to the ferrite rod and ensure perfect alignment. The screw I used had a round head. I wrapped several turns of masking tape on the threads and chucked it up in my drill press. I placed a flat file on the drill press plate and ground the head flat. I then used the file and ground the head diameter down to 1/4". Next I wrapped masking tape around a 1" length of #8 ferrule to make the OD 1/4", then slipped it onto the screw. I then inverted a length of aluminum angle to form a trough and placed the ferrite rod in it. I applied epoxy cement to the head of the screw and placed it with the ferrule in the trough, then pressed it to the rod. This completed the screw and rod assembly. The balance of the coil construction should be self-explanatory, as shown in Fig. 2.

In operation, the coil will exhibit some frequency change when tuned by hand more than 15 to 20 kHz from the crystal frequency. I tried shielding the coil with a 1-1/2" diameter aluminum can and it lost the frequency change ability. However, when mounted within a Radio Shack™ 3" x 5-1/4" x 5-7/8" cabinet (RS #270-253) with the oscillator circuit, it performed satisfactorily. There was no problem with hand capacity detuning. I see no reason why a larger diameter ferrite rod can't be used using the same basic design and I hate to discourage experimentation.

Assembly

The oscillator circuit is shown in Fig. 1. I assembled it, without the coil, on a piece of perf board. C1 and C2 are 100 pF NPO disc capacitors. C3 and C4 are disc type. C5 should be the smallest value that will still provide enough drive to a buffer or multiplier stage. Quality

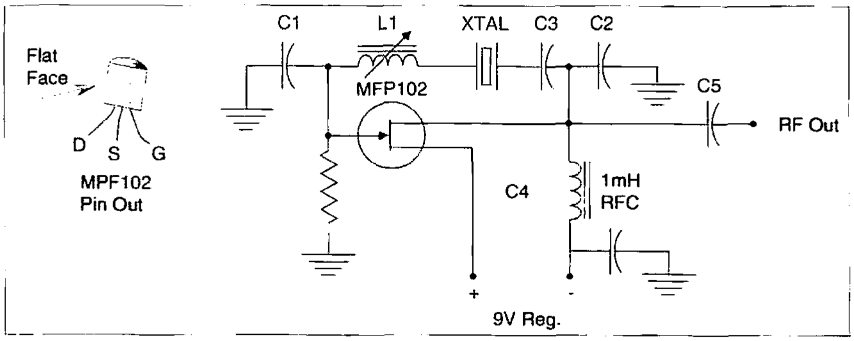


Fig. 1. Oscillator circuit.

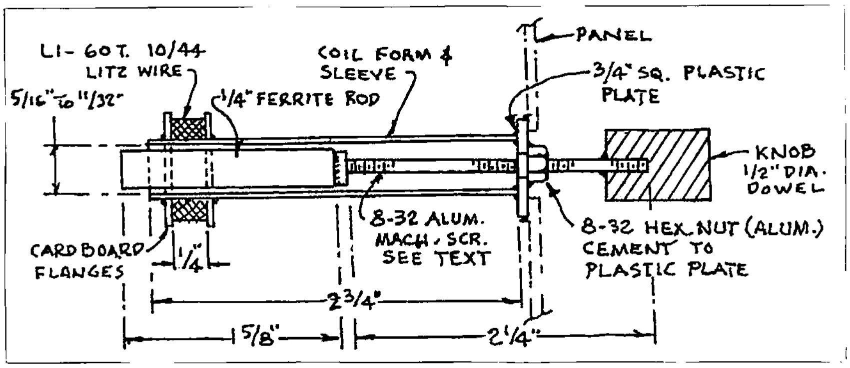


Fig. 2. Construction details.

parts and sturdy construction should be used, as well as voltage regulation.

For additional coverage of the 80 meter band, extra crystals could be used to suit the desired range.

With the ferrite rod withdrawn from the coil, the fundamental frequency is somewhat lower. Mine tuned to 3.578 MHz. At full penetration (the rod centered on the coil), to 3.489 MHz. Of course, the permeability (μ) of the rod will affect this. I would suggest, if possible, using a rod with a μ of over 800.

A frequency counter can be used on the output, or your receiver can be used to zero in on a desired frequency. Tuning is accomplished by turning the screw feed. It will take a little time to become familiar with the tuning as the feed vs. the frequency spread is not linear.

I used DURO™ "QUICK GEL" epoxy cement for all structural connections. It is the first single-solution epoxy cement that I have used that doesn't dry up in the applicator after a few uses. It is extremely strong and sets up fast. For cementing the coil flanges, I used household-type plastic cement.

I have not tried this scheme using other types of oscillator circuits, but you never know what a real "dyed-in-the-wool" experimenter will come up with.

While I don't claim extreme stability at the lowest frequency excursion, I do feel that this circuit could be ideal for QRP transmitters and transceivers.

I might note that many of the transistor AM radios use Litz wire for the antenna coil and some of the larger types use ferrite rods for the antenna (not the flat bar type). Check around for defunct sets. 73

LETTERS

Continued from page 6

Andris "Andy" Neimers VE7FJT. It did my heart good to see John Wagner W8AHB and you tackling the "studious indifference" shown Nikola Tesla by large segments of the US science establishment, even today. I first twigged to the fact that something really rotten was being perpetuated after reading an article on Tesla written by Commander E.J. Quinby in the November 1972 issue of *73*. (As a child he was an eyewitness to Tesla's radio controlled boat demonstration of 1898). Checking some scattered sources, I quickly concluded that a massive snubbing was indeed being perpetuated, given what this genius had invited in his lifetime. It also came to mind that even though I worked as a newspaper reporter for eight years in St. Catharines, Ontario, and visited Niagara Falls hundreds of times, I'd seen no evidence of Nikola Tesla acknowledged as the creative genius behind the power station complexes on both sides of the border. It's quite ironic since there is some evidence that this snubbing was, and still is, based on the hometown boy Edison versus offshore-born Tesla, in Smilijan, Croatia, even though Tesla himself said that getting his US citizenship in 1891 was one of the most cherished and proud moments of his life. The perpetuation of the Edison mystique, and the exclusion of Tesla, extends into US corporate speechwriting - something I am very familiar with. Even today, Edison quotes, wisdoms and sayings abound in speech reference materials, although I believe that some serious research would reveal that much of this Edison folklore is more "Hollywood" than from the man himself. For anybody who wants to get an insight of Tesla's brilliant range of inventions, I would suggest they read *Tesla - Man Out Of Time* "by Margaret Cheney: Dorset Press, New York 1981. I might warn you though that it is depressing reading since It brings Into sharp focus the struggle he had all his life for due recognition. Tesla had one serious weak spot which he wasn't capable of resolving, and it was the fact that his mind was so brilliant, creative, and quite easily bored, that he didn't and wouldn't take the time to bring too many of his projects to market before leaping off into another area of enquiry. Speaking of the "father of radio" aspect, John's short article also didn't have room to mention that among Tesla's accomplishment's was the first demonstration of remote control, by radio, of a model submarine he had built for the First Electrical Exhibition in Madison Square Garden in 1898. The US Navy seriously dropped the ball on that one and didn't pursue it even though they were given first options. I agree - let's grow up and give credit where credit is due - the true story of radio and electrical pioneering in America deserves better than this rather transparent and mean-spirited ignoring of historic facts.

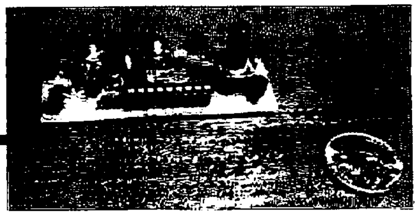
Les Hannibal, Fair Oaks CA. The Tesla article by John Wagener is something I am quite familiar with, since in the early twenties an old friend told of being back in Colorado when Tesla's high voltage equipment blew the power company's generators by the unanticipated RF feedback. He helped rewind those generators. In the 1890s General Electric, under the Westinghouse-Tesla patents, built an experimental set of AC generators which they installed at Folsom prison, where a prison-built dam diverted the flow of the American River. It had two Francis turbines using a 10-foot head of water to run the generators. At the same time G.E. built a power plant in Folsom city, a half mile down stream, using the discharge from the prison installation, but with an 80-foot head. The primary function of the Folsom prison generators were to try out the various multiphase circuits as well as generator and transformer efficiencies. Three-phase delta was found quite effective, so the larger plant in Folsom used the same circuity when it went into operation on July 13, 1895. A three-phase transmission line was installed from Folsom to Sacramento, some 20 miles, and went into operation that same summer of 1895. All of this occurred several months previous to the Niagra Falls plant which Wagener mentions. Knowing the difficulty experienced with leaky insulators on the transcontinental telegraph lines the bar-stool engineers in Sacramento predicted near universally that most of the juice would leak off the transmission line long before it reached Sacramento. Actually, the line loss was under 10%, though the soft copper wire was subject to continual stretching and breakage. But the major difficulty occurred in dry years when there was insufficient flow in the American River for continuous operation. Storage behind the dam was limited, so it was not unusual to see the generators start up every two or three hours and run until the water failed. Streetcars in Sacramento were often stranded. After the tests the Folsom Prison plant was taken over and operated by the prison near continually until 1954, when the Bureau of Reclamation built the Folsom Dam for flood protection and added power. Unfortunately the prison plant with its ancient control panels was dismantled, and Pacific Gas and Electric contemplated doing the same for the Folsom plant. At that time I wrote an S-O-S to Gernsback. He and several associates contacted Black, the president of P.G. & E. I don't know the details, but the Folsom plant has been preserved as a historical monument and is part of the state park system.

Back in 1925 one of my high school teachers asked a class in general science to name the individuals whom they thought had done the most for mankind by their scientific discoveries and inventions. I named Louis Pasteur and Lister in sanitation, and Tesla for polyphase power distribution and equipment. Few of the class had any concept concerning the part that AC power had accomplished in a scant 30 years. How many think to thank Tesla today? 73

73 Review

The Wilderness KC1

An integrated keyer-displayless frequency counter.



Jeff M. Gold AC4HF
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Cookeville TN 38501

Who says you can't take it with you? I love to pack a small QRP transceiver, battery and necessary accessories and take to the trails. Two of my favorite pastimes are hiking and ham radio. The sum of the two is definitely greater than either of the parts. I often make on-the-spot decisions to pack up the goods and get going to one of the many beautiful parks that are not far from my home. Since it is quite easy to forget one or more of the necessary station accessories, I was quite intrigued when I saw Wilderness Radio's first station accessory offering.

"The keyer goes from seven to 50 wpm, and can emulate the two most popular iambic keying modes."

The KC1 is a combined keyer/counter based on a PIC 16C84 microprocessor. The unit is extremely small, .08" tall by 2.5" wide. Though the KC1 wasn't designed to be a replacement for the do-everything home-station keyer or digital frequency counter, it does have a number of very good uses.

This accessory was designed by Wayne Burdick N6KR to be inexpensive and to keep current drain low. To accomplish this, the frequency is reported to the nearest kHz in Morse code through the rig's AF amplifier without keying the rig. You just push a button on the panel anytime you want to know the frequency.

A really neat feature is frequency search. Say you have a schedule to meet someone on a given frequency. You can set the counter to that frequency and when you get to it the unit will alert you. The keyer/counter can store up to four VFO offsets. The KC1 will work with almost any direct conversion or superhet QRP transceiver, whether it's a single or multiband rig. There are only three controls for the unit: a speed pot for the keyer, a message play/record button, and a frequency read/search button.

The second major function of this accessory is as a memory keyer. The keyer goes from seven to 50 wpm, and can emulate the two most popular iambic keying modes. The memory part has variable length message buffers with a total of 50 characters of message memory. It also has a word-repeat macro to save memory. The sending weight and QSK delay are both user programmable and the keyer has an optional sidetone and a tune mode (for use while adjusting an antenna tuner). You can also use a straight key with this unit, though I prefer to be able to have both a straight key and paddles hooked to a unit. I love freedom of choice and sometimes change sending devices mid-QSO.

Assembly

The kit comes in a tiny sealed package and the parts count is very low. You can easily build and install this kit in part of an afternoon without rushing. The printed circuit board is clearly silk-screened and solder masked. One aspect of building this kit is that in order to get the size as small as it is, the parts on the board are densely packed. This should not present much of a problem if you have had any building experience, but you need to make sure that you get the parts on the board correctly on the first try. The board doesn't take kindly to desoldering efforts.

I found the directions very clear and encountered no problems at all in construction. The biggest problem I had was deciding which rig to put this cute little critter in. The instructions tell you how to install the unit in some of the more popular QRP transceiver kits. In addition, there are schematics and information you would need to install it in a kit that isn't listed.

Installation and Operation

With construction completed I finally had to see the little contraption work. It is so small with so few parts that I was bewildered at how it could possibly do all the things the manufacturer claimed. I had recently built a Wilderness Radio NorCal 40A QRP/CW transceiver. It has been one of my favorite rigs to operate and I love to take it portable. It runs for a whole weekend on a very tiny Gel Cell. The rig comes with termination points already available on the printed circuit board to attach the KC1.

The instructions have a template you can cut out to install the KC1 board on either the front or rear panel of the NorCal 40A. Being something of a klutz with a drill, and not wanting to mess up the beautiful blue case of this rig, I chose to install it on the rear panel. I made sure to really take my time and I drilled into a piece of wood so that I wouldn't bend the case. I did manage to do a very neat job and it only took a few minutes to install the KC1 on the back panel. After another few minutes of attaching all the wires from the KC1 board to the NorCal 40A printed circuit board, I was ready for the smoke test.

Smoke tests have always caused me some anxiety. In this case there was double anxiety: Not only was it possible to fry the new accessory, but it was also possible to burn up one of my favorite rigs. I powered up the rig and the KC1 immediately started to speak to me in Morse code, one of my favorite languages. I read through the manual and next entered the command mode of the

Continued on page 43

Facts and Fibs about Preamps

Two do-it-yourselfers.

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When a satellite downlink barely makes it through the noise, one immediately thinks of using a preamplifier. I have built two samples each, one using a bipolar transistor (MRF901), and the other using an FET (BF981).

Both types have a switched bypass to allow transmitting. It's important that the switching works well. "I have 30 dead preamps sitting on a shelf. All had RF up their rear ends," noted friend and fellow ham Irvin Spackman ZL1MO.

Switching

I use a type of single relay that local radiotelephone manufacturers also use. Common lore has it that this is a no-no: you must use a relay at each end. Figs. 1 and 2 show that I have added shunt trimmers at the antenna and at the transmitter end of the relay. These are adjusted for maximum power on a power meter. There is no discernible difference in power between that arrangement and a direct piece of coax.

I have used this switching for both types of preamp, and there is no instability. The amplified output does not talk to the input from the antenna.

"Bipolar transistors have a higher noise figure than FETs," we hear. So they have. But if you use them with an omnidirectional antenna into an untuned front end, the received noise will mask the noise of the active device, even at VHF levels. Hence, having an improvement of 0.6 dB in noise reduction is not going to make an improvement in recovered signal. You start worrying about noise figures when you use a helical array into a cavity filter.

I used the MRF901 with resistor biasing only, with Pi- matching. I can't measure gain, but the S-meter on the FT-290 and TR9130 goes from 0 to 9 when the preamp is switched on.

"You cannot use Vero-board construction at VHF," is another objection. My preamps are dashed off on Vero-board. I did need to solder together all unused tracks and tie them to ground through the stand-offs. The signal paths were kept short, as in "dead bug" construction. On the first FET preamp I had the two tuning

> ***"The modern synthesized transceivers have untuned front ends. The mixer therefore has to discriminate from signals off the desired frequency."***

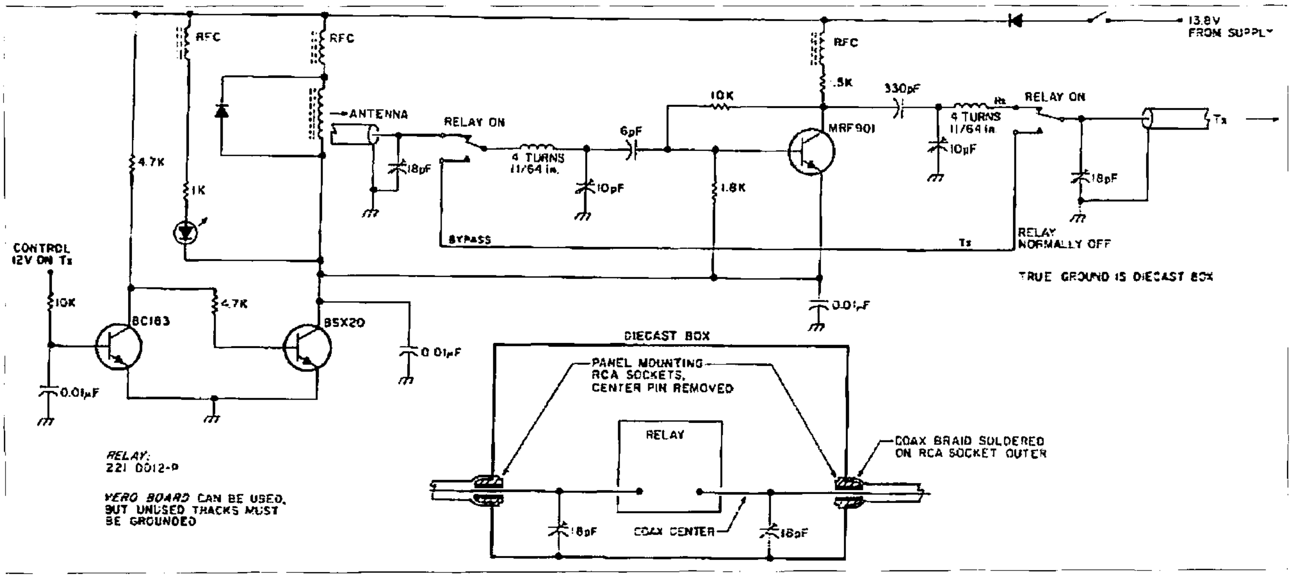

Fig. 1. A simple preamp that actually works.

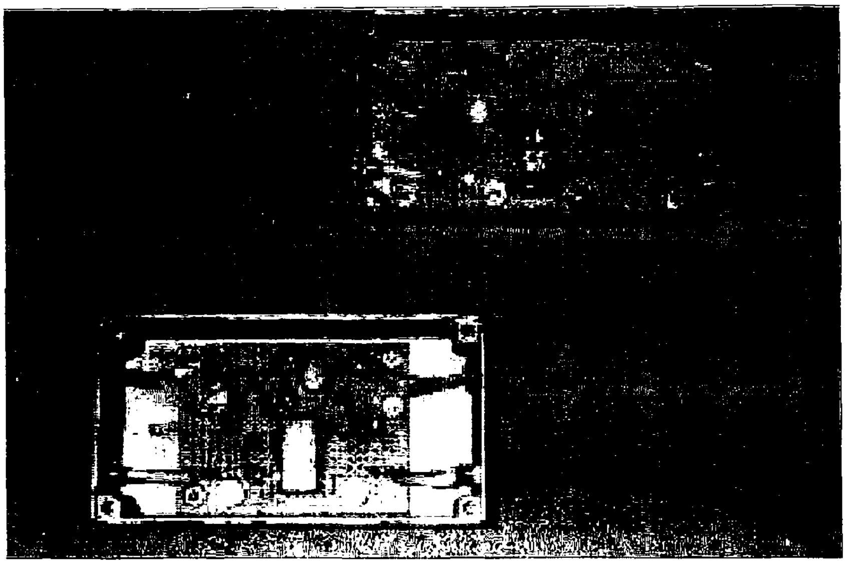

Photo A. A bipolar transistor preamplifier at the top (MRF901), and an FET preamp at the bottom (BF981). Both have the same RX-TX switching using a single relay and the die-cast box as the ground reference for the preamp. The box also is in the direct return path from the antenna.

coils too close together. The device became an oscillator. Screening between the two made no difference. The layout of the second FET preamp has the coils farther apart. Input and output signal paths are separated by grounded tracks, except within the relay. The preamp is stable, and the tuned circuits are non-critical.

Preamp Placement

"You must use preamps at the antenna feed point," say the Good Books. My feedlines are 25 feet of half-inch coax. The loss at 146 MHz is 0.7 dB for RG-8U. My preamps are a two-foot length of coax away from the transceiver. Power and transmit control voltage are brought out through the back of the linear amplifier of the FT-290ORII by a stereo lead and socket. The preamps have a stereo lead and plug, so they are removable. With a two-foot supply and control connection, the voltage drops are negligible.

I will allow that my first preamp had plenty of gain, but on FM there appeared to be no improvement in signal-to-noise ratio. The satellites did not open the squelch earlier with the preamp than they did without. It was a bipolar version, the board mounted on four metal stand-offs on the aluminum bottom cover of a plastic box. The box was lined internally with screening foil that touched the aluminum plate when closed. The braid from input and output coax was tied to the stand-offs.

Not Just a Container

I resolved to use a die-cast box, as shown in the photographs. I found panel-mounting RCA sockets, and removed the center contacts. I fed the coax centers through them and soldered the coax braid to the outer contacts of the RCA sockets. With the ground tracks of the PC board connected through metal stand-offs, the die-cast box was no longer merely a shell. It became the ground reference for the preamp and it substituted for the coax shielding in the return path from the antenna, without any discontinuity.

The resulting increase in signal over noise, together with a home-designed turnstile, allows me to decode ASCII from OSCAR-11 with as few as 50 errors over 10 kbytes, when the telemetry says the satellite is transmitting at 200 mW.

I built the FET preamp, with the same relay switching and the same boxing technique, because Irvin ZL1MO does not like

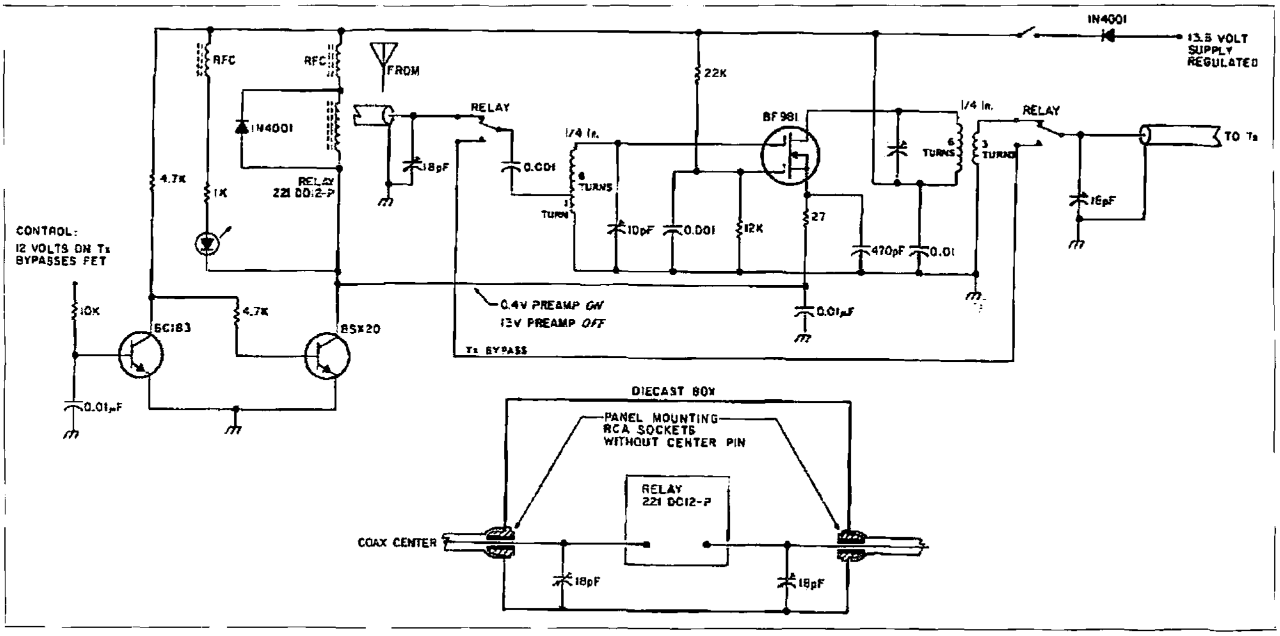

Fig. 2. The AMSAT-UK FET preamp with RX-TX switching added.

bipolar transistors with Pi-matching instead of tuned circuits. The FET version (BF981) does have a slight increase in gain, and improvement in signal-to-noise ratio. This is because tuned circuits do provide more rejection of out-of-band signals than Pi-matching does.

A Question of Gain

"You can't have too much gain," is another popular belief. Not true. The modern synthesized transceivers have untuned front ends. The mixer therefore has to discriminate from signals off the desired frequency. With more than 15 to 20 dB gain, your multimode rig will respond to the guy next door doing a bit of repeater-bashing, as well as to passing taxis and marine weather broadcasts. Handhelds convulse with any kind of preamp. My IC32AT even protests when I stick it on the slim Jim on the roof.

All being said, the two simple preamps described have become a useful addition to my shack. By taking into account what kind of antenna and transceiver they have to work with, and how the preamps are interfaced, I obtain results that compare well with what other amateurs achieve. Just yesterday a visiting British amateur, looking at an OSCAR-11 bulletin, remarked: "There's no error in it, is there?" 73

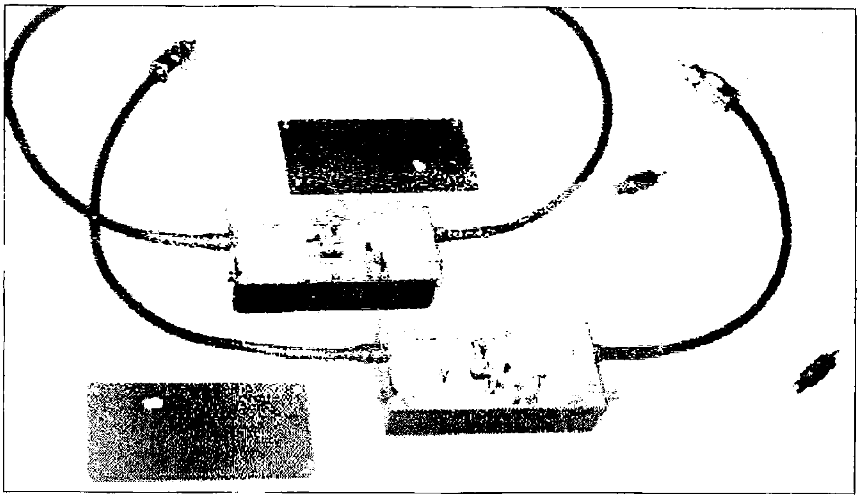

Photo B. These preamps can be used near the transmitter due to the boxing technique. Short stereo leads carry the power supply and the TX control voltage. With no voltage drop, the preamps and their switching work reliably.

NEVER SAY DIE

Continued from page 28

the Admiral in his office in the Pentagon. He was a short chap, so he had his desk up on a platform to add to his stature. Unless we published an apology immediately he'd see that no firm having any military contracts would ever advertise in the magazine.

We apologized.

Jim didn't get permission to use the ham station on the ship, but he did have a great trip to Antarctica and we got some good stories from it as he visited the Antarctic MARS stations.

Now cut to a couple years later, when I was the president of the Porsche Club of America and had an opportunity to visit the factory on a club-sponsored tour. I was happy with the Porsche Speedster I'd bought in 1957, so I arranged to pick up a new Porsche for a ham friend who couldn't get away for the trip. Our group of 150 flew over

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Number 44 on your Feedback card

73 Review

The New Index Laboratories QRP Plus Transceiver

Check out this tiny, full-function QRP HF transceiver

Robert S. Capon WA3ULH
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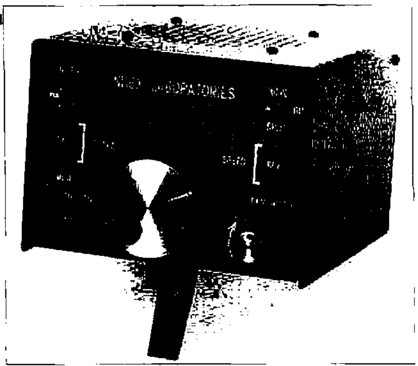
Index Laboratories has introduced a new version of its "QRP Plus" HF transceiver: an all-band, digital, 5-watt transceiver with many of the features usually found in full-sized transceivers. New features include a speech processor, improved AGC, and a significantly improved front end to the receiver.

The feature set is impressive:

- CW and SSB
- 10m - 160m
- Variable power output (0 - 5+ W)
- General coverage receiver (1.8 - 30 MHz)
- Variable bandwidth digital filter (100-2400 Hz)
- 20 memories
- Split frequency
- RIT/XIT
- Full QSK
- AGC
- Speech processor
- 2-function meter: S-meter, power meter
- Built-in keyer
- Current drain: 140 mA receive; 1.5 A transmit
- Dimensions: 5.5"w x 4.5"h x 6"d
- Weight: 5.0 lbs.

The major breakthrough is its exceptionally low current drain on receive, which is of critical importance for portable QRP operation, since the current drain determines the size battery you need. For example, most full-sized digital transceivers and miniature mobile HF rigs require 1-1.5A on receive. At this current drain you're using 24-36 amp-hours for 24 hours of operation, plus the added current drain when you're transmitting. These radios require a substantial sized marine battery or a generator for Field Day or for a weekend outing. For this reason, backpacking and bicycling aren't feasible with most commercial radios.

Index recognized the need for a full-function digital HF transceiver and designed the QRP Plus with low power drain as a central benefit in its design of the radio. It uses only 140 mA on receive! That's about 3 amp-hours for 24 hours. Thus, you can get through Field Day with a 6 amp-hour gel cell, even with a heavy-duty cycle of transmitting.



Getting Started

"Wow, is this a solidly built radio." The tiny steel cabinet fits neatly into my fishing tackle box, which I use for portable operation. It weighs in at five pounds; I had the feeling that I was holding a "radio brick." If you drop it on your foot, I'll bet on the radio.

It uses an SO-239 jack for the antenna, and a standard DC plug for the 12-volt input. It requires an accessory speaker-type microphone commonly used in VHF and UHF handie-talkies. Since there are no mounting holes or a mobile bracket, you will have to be resourceful to mount the rig in your automobile.

The radio's extremely small size required the combining of controls, making some functions of the radio not completely intuitive. For example, the keyer speed is displayed in words per minute by pressing both the Bandwidth and the Rev buttons at the same time. The main tuning knob adjusts the speed in 5 wpm increments. When the Bandwidth button is pressed the bandwidth is displayed, along with the SSB/CW display. To change modes you push the Fast button while holding in the Bandwidth button. The memory of frequencies is stored by pressing the Fast and Mem buttons simultaneously.

"Because of its exceptionally low current drain, this rig is a natural choice for backpacking, bicycle mobile, boating, taking on business or vacation trips, and of course, Field Day."

Most of the other functions of the radio *are* intuitive. For example, to change the bandwidth of the variable filter, you press the Bandwidth button and turn the main tuning knob. You press and hold the Fast button to tune quickly across the band. I quickly became accustomed to the radio, and found it to be easy to use. The built-in tilt stand is very handy for use in the field. Also, the tuning knob is very solid, and comes with a convenient dimple that makes it a pleasure to tune.

The power-efficient high contrast LCD display with large numbers is an excellent choice for use in sunlight. I tested the rig at night using only a single candle and was easily able to read the display. However, a small external

source of front lighting is needed to read the LCD display.

The radio automatically selects either LSB for the low bands or USB for the high bands, and you can't override the selection.

Operating Results

When using the radio I had the feeling that next year I can leave a lot of my favorite accessories at home because they're already built into this little radio. These built-in accessories include an power meter, electronic keyer, audio filter, and output attenuator.

I began putting the radio through its paces by checking its calibration against WWV, and against my big HF rig. The radio was in excellent calibration across all amateur bands, and on the WWV frequencies it was within 100 Hz. The receiver is on par with my full-sized HF transceiver. The AGC and the receiver front end showed significant improvement over the original version. It has excellent audio output to either a built-in 4-inch speaker or headphones. It's compatible with inexpensive *stereo* headphones rather than the harder to find *mono* headphones. I especially appreciated the variable bandwidth digital filter (100-2400 Hz in 100 Hz increments), which I wish I had on my full-sized HF rig.

I really appreciate having a general coverage receiver built into any amateur transceiver since I like to be able to listen to the news when I am out in the field or on a trip. The SSB sound is okay for news broadcasts, but for music an AM mode would help.

I fired up the transmitter and made some contacts. The QSK is very good, but is not the radio's strongest feature. I varied the power control on the back of the radio and found that the power output on 20 meters varied between zero and 7 watts, making the rig an excellent choice for QRPp work, especially as the solar cycle progresses and band conditions improve.

The original model delivered full power on CW, but had reduced power output on SSB, since it lacked a speech processor. The new model showed significant improvement in SSB power output.

My good friend Ernie AD4VA, who lives about two miles away and helps me test all of my ham radio projects, gave a critical listen to the CW signal and to the audio quality on phone. He couldn't distinguish between the CW signal of the QRP Plus and that of my full-sized transceiver. He also reported that it has very clear crisp audio on phone. Thumbs up.

I put the radio on the air to see what I could work running 5 watts into a run-of-the-mill tribander. I spent a few evenings working plenty of DX, including UA6HZ in European Russia, YQ9A in Romania, and SP9BRP in Poland who said: "Congrats on FB 5W QRP, Rob". On SSB I worked EA8BM in the Canary Islands, GIØAIJ from Northern Ireland and EA7AYD from Spain, who said: "Many congratulations with your 5 watts." EA8BM and GIØAIJ both gave me a signal report of 56.

The 20 memories, along with the fast slewing control, make it very easy to change bands. I set up the memories to the center of my favorite bands, and to WWV and the BBC.

Another nice feature is the radio's ability to toggle between the current memory frequency and the last frequency in the VFO, so you can quickly jump back to an interesting frequency. If used properly this feature is similar to having one band-stacking register, which can be very convenient.

Applications

Because of its exceptionally low current drain, this rig is a natural choice for backpacking, bicycle mobile, boating, taking on business or vacation trips, and of course, Field Day. It's also ideal for solar power applications. The radio can be operated at full break-even with a 5-10 watt solar panel charging on a sunny day.

Another application is as a second receiver to monitor the downlink during HF satellite operation on Russian satellite RS-12. In this mode, I uplink the signal using my base station, and monitor the downlink with the QRP Plus.

It can be used in the car, but the absence of a noise blanker is a problem. Even as a veteran QRP person, I find it challenging to work with a 12 dB power penalty combined with a 3 dB mobile antenna penalty. And the car is one place where I don't have to worry too much about current drain, because the car's electrical system can furnish all the current I need.

The Manufacturer

Index Labs is a small company new to the amateur radio business. When the QRP Plus first came out a year ago the company suffered from an inability to meet the demand. The company has matured during the past year and now maintains an inventory of radios so it is able to deliver from stock.

What's Missing?

Not much. A memory keyer would be a nice feature for QRP contests like Field Day. I predict that more and more commercial radios will include memory keyers as a standard feature. A noise blanker and an SWR function for the S-meter would be handy. Maybe on Version III next year?

The Wilderness KC1

Continued from page 40

KC1 and programmed in the offset. The numbers to send in Morse code to the KC1 were printed in the instruction manual so this only took a few seconds. I exited the command mode and pushed the frequency check button. To my great amazement it gave me the frequency. Not believing it right off the bat, I turned on my main station rig and tested the results across the NorCal's band. The little gadget was right on the money.

I next tested out the keyer memory functions. I found it very simple to program in a message and play it back. I used the NorCal 40A with the keyer in the ARRL Sweepstakes contest over the weekend and encountered no problems. As a matter of fact, I only had to repeat an exchange twice during the entire time I operated. This is quite good considering the length of the exchange in this contest and the fact that I was using 1.8 watts and a vertical antenna.

I was quite pleased building and operating this accessory and look forward to taking the rig hiking and camping.

The kit is offered in two versions. There is a complete kit which has the PCB and all board mounted components. You may still need to provide a few components, such as the key jack of your choice and a resistor or capacitor or two to match the accessory to your QRP kit. There is also a partial kit which includes the programmed microprocessor, 4 MHz crystal, all three transistors and the manual.

Official DX Dynasty Countries List: 3/96

AFGHANISTAN	YAØ
AGALEGA ISLAND	3B6
ALAND ISLANDS	OHO
ALASKA	AL7, KL7, WL7
ALBANIA	ZA1
ALGERIA	7T-7Y
AMERICAN SAMOA	KH8, AH8
AMSTERDAM & ST PAUL ISL	FT8Z
ANDAMAN ISLAND	VU
ANDORRA	C3
ANGOLA	D2, D3
ANGUILLA	VP2E
ANNABON ISLAND	3CØ
ANTARCTICA	CE9, KC4
ANTIGUA	V2
ARGENTINA	LO-LW
ARMENIA	EK
ARUBA	P4
ASIATIC RUSSIA	UA-UI8,9,0, RA-RZ
ASCENSION ISLAND	ZD8
AUCKLAND ISLAND	ZL9
AUSTRALIA	VK
AUSTRIA	OE
AVES ISLAND	YVO
AZERBAIJAN	4J, 4K
AZORES ISLANDS	CU
BAHAMA ISLANDS	C6
BAHRAIN	A9
BAKER ISLAND	KH1
BALEARIC ISLANDS	EA6-EH6
BANABA ISLAND	T33
BANGLADESH	S2
BARBADOS	8P
BARBUDA	V2
BELARUS	EU-EW
BELGIUM	ON-OT
BELIZE	V3
BENIN	TY
BERMUDA	VP9
BHUTAN	A5
BOLIVIA	CP
BONAIRE, CURACAO	PJ2,4,9
BOTSWANA	A2
BOVET ISLAND	3Y
BRAZIL	PP-PY
BRIT CYPRUS	ZC4
BRITISH VIRGIN ISLANDS	VP2V
BRUNEI	V8
BOSNIA-HERZEGOVINA	T9, 4N4, YU4
BOUVET	3Y
BULGARIA	LZ
BURKINA FASO	XT
BURUNDI	9U
CAMBODIA	XU
CAMEROON	TJ
CAMPBELL ISLAND	ZL9
CANADA	VE, VO, VY
CANARY ISLANDS	EA8-EH8
CAPE VERDE ISLANDS	D4
CAYMAN ISLANDS	ZF
CENTRAL AFRICAN REPUBLIC	TL
CENTRAL KIRIBATI	T3
CEUTA AND MELILLA	EA9-EH9
CHAD	TT
CHAGOS	VQ9
CHATHAM ISLAND	ZL7
CHILE	CA-CE
CHINA	BY, BT
CHRISTMAS ISLAND	VK9X
CLIPPERTON ISLAND	FOØ
COCOS ISLAND	TI9
COCOS KEELING ISLAND	VK9C
COLOMBIA	HJ, HK
COMOROS	D6
CONGO	TN
CONWAY REEF	3D2
COOK ISLAND	ZK1
CORSICA	TK
COSTA RICA	TI, TE
CRETE	SV9
CROATIA	9A, YU2
CROZET ISLAND	FT8W
CUBA	CM, CO
CURACAO	PJ
CYPRUS	5B
CZECH REPUBLIC	OK, OL
DENMARK	OZ
DESECHEO ISLAND	KP5
DJIBOUTI	J2
DODECANESE ISLANDS	SV5
DOMINICA	J7
DOMINICAN REPUBLIC	HI
EASTER ISLAND	CEØ
EAST KIRIBATI	T32
EAST MALAYSIA	9M6, 9M8
ECUADOR	HC, HD
EGYPT	SU
EL SALVADOR	YS
ENGLAND	G, GX
EQUATORIAL GUINEA	3C
ESTONIA	ES
ERITREA	E3
ETHIOPIA	ET
EUROPA ISLAND	FR/E
EUROPEAN RUSSIA	UA-UL1,3,4,6, RA-RZ
FALKLAND ISLANDS	VP8
FAROE ISLANDS	OY
FERNANDO DE NORONHA	PPO, PYO
FIJI ISLANDS	3D2
FINLAND	OF-OI
FRANCE	F
FRANZ JOSEPH LAND	4K2, UA1
FRENCH GUIANA	FY
FRENCH POLYNESIA	FO
FUTUNA ISLAND	FW
GABON	TR
GALAPAGOS ISLAND	HC8, HD8
GAMBIA	C5
GEORGIA	4L
GHANA	9G
GIBRALTAR	ZB2
GLORIOSO ISLAND	FR/G
GOUGH ISLAND	ZD9
GOZO ISLAND	9H
GREECE	SV-SZ
GREENLAND	OX
GRENADA	J3
GUADELOUPE	FG
GUAM	KH2
GUANTANAMO BAY	KG4
GUATEMALA	TG, TD
GUERNSEY	GU
GUINEA	3X
GUINEA-BISSAU	J5
GUYANA	8R
HAITI	HH
HAWAII	KH6
HEARD ISLAND	VKO
HONDURAS	HQ, HR
HONG KONG	VS6
HOWLAND ISLAND	KH1
HUNGARY	HA, HG
ICELAND	TF
INDIA	VU
INDONESIA	YE-YH
IRAN	EP, EQ
IRAQ	YI
IRELAND	EI, EJ
ISLE OF MAN	GD, GT
ISRAEL	4X, 4Z
ITALY	1
ITU GENEVA	4U
IVORY COAST	TU
JAMAICA	6Y
JAN MAYEN ISLAND	JX
JAPAN	JA-JS
JARVIS ISLAND	KH5
JERSEY	GJ, GH
JOHNSTON ISLAND	KH3
JORDAN	JY
JUAN DE NOVA ISLAND	FR/J
JUAN FERNANDEZ ISL.	CEO
KALININGRAD	UA2
KAZAKHSTAN	UN, UQ
KENYA	5Y-5Z
KERGUELEN ISLAND	FT8X
KERMADEC ISLAND	ZL8
KINGMAN REEF	KH5K
KURE ISLAND	KH7
KUWAIT	9K
KYRGYZSTAN	EX
LACCADIVE ISLANDS	VU
LAOS	XW
LATVIA	YL, UQ
LEBANON	OD
LESOTHO	7P
LIBERIA	EL
LIBYA	5A
LIECHTENSTEIN	HBØ
LITHUANIA	LY, UP
LORD HOWE ISLAND	VK9L
LUXEMBOURG	LX
MACAO	XX9
MACEDONIA	Z3, 4N5, YU5
MACQUARIE ISLAND	VKØ
MADAGASCAR	5R
MADEIRA ISLAND	CT3
MALAWI	7Q
MALDIVE ISLANDS	8Q
MALI	TZ
MALPELO	HKØ
MALTA	9H
MALYJ-VYSTOSKIJ (M-V) ISLAND	4J1
MARIANA ISLAND	KHØ
MARION ISLAND	ZS8
MARKET REEF	OJØ
MARSHALL ISLAND	V7
MARTINIQUE	FM
MAURITANIA	5T
MAURITIUS ISLAND	3B8
MELLISH REEF	VK9M
MEXICO	XA-XI
MICRONESIA	V6
MIDWAY ISLAND	KH4
MINAMI TORI SHIMA	JD1
MOLDOVA	ER
MONACO	3A
MONGOLIA	JT-JV
MONTSERRAT	VP2M
MOROCCO	CN
MOUNT ATHOS	SV/A
MOZAMBIQUE	C9
MYANMAR	XY, XZ
NAMIBIA	V5
NAURU	C2
NAVASSA ISLAND	KP1
NEPAL	9N
NETHERLANDS	PA-PI
NETHERLANDS ANTILLES	PJ
NEVIS ISLAND	V4
NEW CALEDONIA	FK
NEW ZEALAND	ZL, ZM
NICARAGUA	YN
NICOBAR ISLAND	VU
NIGER	5U
NIGERIA	5N, 5O

NIUE ISLAND	ZK2
NORFOLK ISLAND	VK9N
NORTHERN IRELAND	GI
NORWAY	LA
OGASAWARA ISLAND	JD1
OMAN	A4
PAKISTAN	AP-AS
PALMYRA ISLAND	KH5
PANAMA	HO, HP
PAPUA NEW GUINEA	P2
PARAGUAY	ZP
PERU	OA-OC
PETER 1ST ISLAND	3Y
PHILIPPINES	DU-DZ
PHOENIX	T31
PITCAIRN ISLAND	VR6
POLAND	SN-SR
PORTUGAL	CQ, CT
PRINCE EDWARD ISLAND	ZS8
PRINCIPE	S9
PROVIDENCIA ISLAND	HKØ
PUERTO RICO	KP3, KP4
QATAR	A7
REUNION ISLAND	FR/R
REVILLA GIGEDO ISLAND	XA4-XI4
RODRIGUEZ ISLAND	3B9
ROMANIA	YO-YR
ROTUMA ISLAND	3D2
RWANDA	9X
SABLE ISLAND	CYØ
SAN ANDRES ISLAND	HKØ
SAN FELIX & SAN AMBROSIO	CEØ
SAN MARINO	T7
SAO TOME	S9
SARDINIA	I
SAUDIA ARABIA	HZ
SCOTLAND	GM
SENEGAL	6V, 6W
SEYCHELLES	S79
SIERRA LEONE	9L
SINGAPORE	9V
SINT MAARTEN, SABA, & SINT EUSTATIUS ISL.	PJ5-8
SLOVAK REPUBLIC	OM
SLOVENIA	S5, YU3
SMOM (MALTA)	1AØ
SOCOTRA ISLAND	7O
SOLOMON ISLANDS	H4
SOMALIA	T5
SOUTH AFRICA	ZR-ZU
SOUTHERN SUDAN	STØ
SOUTH GEORGIA ISLAND	VP8, LU
SOUTH KOREA	HL
SOUTH ORKNEY ISLAND	VP8,LU
SOUTH SANDWICH ISLAND	VP8, LU
SOUTH SHETLAND ISLAND	VP8, LU, CE9, HFØ, 4K1
SPAIN	EA-EH
SPRATLY ISLAND	1S
SRI LANKA	4P-4S
ST BRANDON ISLAND	3B7
ST HELENA ISLAND	ZD7
ST KITTS	V4
ST LUCIA	J6
ST MARTIN ISLAND	FJ-FS
ST PETER AND PAUL ROCKS	PPO-PYØ
ST PIERRE ISL. & MIQUELON	FP
ST PAUL ISLAND	CY9
ST VINCENT	J8
SUDAN	ST
SURINAM	PZ
SVALBARD ISLAND	JW
SWAZILAND	3DA
SWEDEN	SA-SM
SWITZERLAND	HB
SYRIA	YK
TADZHIK	UJ
TAIWAN	BV
TAJIKISTAN	EY
TANZANIA	5H, 5I
TASMANIA	VK7
THAILAND	HS
TOGO	5V
TOKELAU	ZK3
TONGA ISLAND	A3
TRINIDADE AND MARTIM VAZ	PPO, PYØ
TRINIDAD & TOBAGO	9Y
TRISTAN DE CUNHA	ZD9
TROMELIN ISLAND	FR/T
TUNISIA	3V
TURKEY	TA-TC
TURKMENISTAN	EZ
TURKS AND CAICOS ISLANDS	VP5
TUVALU	T2
UGANDA	5X
UKRAINE	UR-UZ, EM-EO
UNITED ARAB EMIRATES	A6
UNITED NATIONS-GENEVA	4U1
UNITED NATIONS-NEW YORK	4U
UNITED NATIONS-VIENNA	4U1
UNITED STATES OF AM.ERICA	K, W, N, AA-AK
URUGUAY	CV-CX
UZBEKISTAN	UJ, UM
VANUATU	YJ
VATICAN CITY	HV
VENEZUELA	YV-YY
VIETNAM	3W, XV
VIRGIN ISLANDS	KP2
WAKE ISLAND	KH9
WALES	GC, GW
WALLIS ISLAND	FW
WAYNE GREEN	W2NSD
WESTERN CAROLINE ISLAND	KC6
WEST GERMANY	DA-DL, Y2-Y9
WEST KIRIBATI	T3Ø
WESTERN SAHARA	SØ
WESTERN SAMOA	5W
WEST MALAYSIA	9M2, 9M4
WILLIS ISLAND	VK9W
WORLD BANK	4U1
YEMEN	7O
YUGOSLAVIA	YT, YU, YZ
YUKON	VY1

NEVER SAY DIE

Continued from page 43

on Lufthansa and were met by the Porsche people, who delivered our cars to us in front of nearby Solitude Castle. Then we got to drive them on the Solitude race track, which was closed to traffic so it formed a track about five miles around. Porsche had their top racing drivers there to teach us how to handle the cars at speed on the tight curves.

From there I drove to Paris, where the local hams had organized a party for me. And Admiral Bruton, who was now the head of American Expeditionary Forces in Europe, came to the party just to see me and we had a great time. All was forgiven. From there I drove to Geneva to meet the hams at 4U1ITU.

The ITU hams showed me all around the place and then filled me in on what was happening. It seems that the next major ITU meeting was next year (1959) and that they felt amateur radio was in serious trouble. Many countries were petitioning the ITU to cut the ham bands significantly, plus we had almost no support from the smaller countries of the world, where amateur radio was either unknown, or was an annoyance. To make it worse, when American hams visited these small countries they'd promise them anything to get a license and then would ignore their promises and violate their rules, running excess power and making phone patches. So amateur radio had left a bad taste with these countries.

These are the same small countries who'd been shafted by the previous ITU conference when the frequency allocations had been made. The big countries grabbed anything of any value, and left the small countries with the scraps. India was coming to the conference officially requesting that all ham bands be cut to 50 kHz, which was more than enough for their few hundred hams. Australia was officially requesting that our bands all be cut to 100 kHz. And not one country, including the US, was suggesting they be enlarged. What a terrible bargaining position!

But what about the ARRL, I asked? Sure, I'd had serious problems fighting the ARRL to get RTTY permitted below 2m. They had pulled every dirty trick they could to stop RTTY from being used on the HF bands, fearing that it was a threat to their CW traffic system. I knew how the chaps at the FCC hated the League for their arrogance, but I was unprepared for the anger and disgust the ITU people expressed.

They told me how Budlong, the ARRL General Manager for around 20 years, had represented the US at a previous conference and had had to be thrown out of meetings because he arrived drunk and brought local prostitutes with him. And all this, plus a sumptuous suite in the most expensive hotel in town, all unquestioningly paid for by the ARRL members.

This didn't really surprise me because, though I'd met Budlong many times at hamfests, I'd never seen him sober.

When I got back home I called Budlong offering, in light of the

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HAMS WITH CLASS

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A Vacation To Remember

One of the best perks of teaching ham radio classes is the fun of tracking the children's adventures once they're on their own with radio. One of last year's graduates that I took a particular interest in was Jesse Warren KB2VAK. Jesse was in my radio class at our school—Intermediate School 72 in Staten Island, New York.

Most of the 400+ students who come through the ham radio program each term find something in the curriculum that they can have fun with and relate to. Every once in a while, however, a student really distinguishes him- or herself with an exceptionally enthusiastic attitude towards ham radio. These are the students who give up lunch periods to come back to my room and sit in the "shack" to both listen and speak. I can spot that eagerness a mile away. They just can't get enough!

Jesse impressed me with his enthusiasm right from the beginning. His questions were always intelligent and thoughtful. He is definitely the kind of youngster who will contribute to and benefit from our hobby and service. While he was studying for his novice ticket in my class, he took my advice and "hooked" a parent into studying with him. Jesse's dad Richard enjoyed studying with his son, and was soon totally caught up in the wonderful world of ham radio. Richard is KB2VAM and has his General license.

As luck would have it, Jesse's family moved to Long Island, New York after he completed 7th grade. We stayed in touch via radio and phone. Last summer, Jesse very excitedly informed me that he and his family were planning a trip to Israel and Austria. I was delighted to learn that part of their preparations included trying to get reciprocal operating privileges in these countries. Unfortunately they weren't able to get operating privileges in Israel in time for the trip. Both Jesse and his father did, however, enjoy listening while they were there.

In Austria, Jesse had a big thrill when he spoke on a Vienna repeater to a ham in Slovakia. Can you imagine the enrichment the radio provided to a 13-year-old from New York? Not only did Jesse and his dad have a more exciting vacation because of their radio contacts, but so did the rest of the family. Younger brother Zach was totally intrigued by the excitement generated by the ham contacts. Mother, Barbara, who is a former colleague of mine, has resisted the urging to get her own license so far but enjoyed watching Jesse and his dad reaching out together for all these wonderful experiences.

"In Austria, Jesse had a big thrill when he spoke on a Vienna repeater to a ham in Slovakia."

During the six week trip, Jesse made contacts with many stations, and listened to many more. Some of the more memorable contacts were with stations in Vienna, Luxembourg and Slovakia. Some were on simplex and others were on repeaters.

Jesse offers the following advice: "Prior to leaving on a trip, it's important to apply for your reciprocal license well ahead of time. Leave a minimum of four weeks for processing. You may also have to list a local address on your application. Although I didn't receive my license in Israel because I hadn't allowed enough time, I did receive it in Austria because I was staying with my cousin and he received it at his local post office. I found it interesting to learn that Austrian regulations for radio are much stricter than in the United States. For example, you have to copy code at 20 words per minute without making a mistake. In addition, there is no third party traffic. Also, if you are caught listening to a ham radio without being licensed, you must pay a large fine. You must be 16 years old to get a license in Austria."

Jesse and his dad were pleased to learn that many hams in Israel and Austria spoke English. On the two Vienna repeaters 146.625 and 146.75 MHz, hams were eager to speak with them because of their American callsigns—KB2VAK/OE. When Jesse got home and contacted me, he told me he was very excited about increasing his code speed so that he could get more HF privileges by upgrading from Tech Plus to General and even higher.

I often wonder about the influence of ham radio classes on my former students, influences as varied as the children themselves. Each one finds his own particular niche and relevance. Many of the older children choose a particular course of study in college as a result of something they remembered that they liked in ham radio class. Others go the route of getting involved in community events such as walk-a-thons, parades, and other fund raisers. Some youngsters help provide communications during certain holidays with the REACT group in our area. Many, like Jesse, incorporate the radio into their daily lives. Events like family vacations become more fun and more meaningful to them because they're able to meet new friends in new places right from the palms of their hands. 73

Photo A. Jesse and Zach in Vienna under a statue of Johann Strauss.

A Stealth 40-10 Meter Antenna

An indoor antenna for the desperate that works from 40m through 10m.

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A 40 meter dipole is approximately 66 feet long. Used with an antenna tuner it will do a fine job from 40 through 10 meters, an excellent selection of frequencies now that sunspots are once again decorating Old Sol. But for those unfortunate hams who live where space, zoning laws, deed restrictions or the regulations of Homeowners' Associations prevent the installation of outdoor antennas, there are a number of possible antennas which, while not as effective as outdoor antennas installed high and in the clear, will still produce a respectable number of QSOs.

Most of us are aware of such antennas: dipoles in the attic; flagpole antennas; fine gauge wire running out a window to a handy tree; mobile whip antennas; tuned high-Q loops; a weighted wire dropped out of an apartment window at night; rain gutters and downspouts; etc. Some work better than others. A few require good ground systems (often more of a problem than the antenna itself). However, balanced antennas do not require a ground, so let's go that route.

The part of the antenna that does most of the radiating is the high-current portion. In a dipole this is the wires on either side of the center feed point insulator. For a horizontal antenna this portion of the wire should be as horizontal as possible, and at the highest point above ground that you can manage. If there isn't sufficient space in a horizontal line for all of the antenna wire, and there won't be, the ends can be bent to fit the antenna into the available space. Since it's a balanced, center-fed antenna, a dipole does not require a ground system.

"It blends into the background so well your XYL won't even notice it!"

Of all the possible configurations of indoor antennas made of wire, the dipole in the attic is probably the best because it is as far above ground level as possible, and usually less of the ends must be bent to fit the space. However, if heating or air conditioning ducts run through the attic, they may absorb much of your RF, cutting your antenna off at the knees, so to speak. AC wiring running through the attic can also absorb your power.

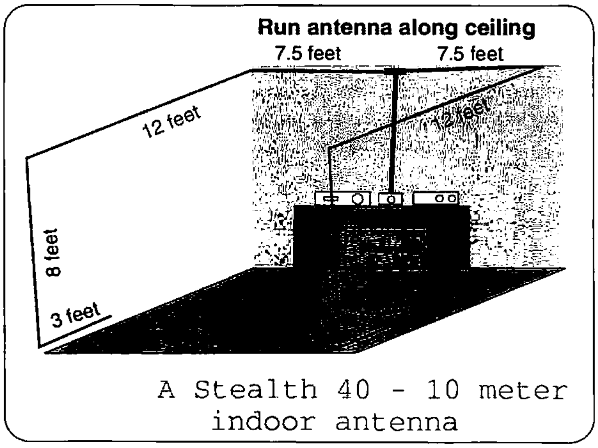

Fig. 1. Antenna installation diagram.

Another Dipole Option

For hams who don't have access to an attic, but do have one room at least 12 feet by 15 feet, with an (approximately) 8-foot ceiling, the 40 meter antenna I used will provide very good results from 40 through 10 meters when used with an antenna tuner. It also blends into the background so completely your friends may not even notice it!

Fully 39-feet of the radiating section of this 66-foot dipole are horizontal at the top of the room. See the drawing, which illustrates the entire installation. The insulator at the feed point is centered along the 15-foot outer wall, up against the ceiling. The center span is 15 feet long. From the ends of these points, where the wires meet the end walls, they turn 90 degrees and run along the tops of both 12-foot side walls, leaving approximately 11 feet of wire at each end. These wires are then dropped to the floor, and the remaining three feet at each end is bent along the baseboard in any direction. *Caution:* Be sure to tape the antenna ends with plastic tape so children or pets can't touch them accidentally and get an RF burn. The antenna ends develop high voltages when transmitting; keep them away from anything metal so you won't start smelling smoke.

Of course, insulated wire—ordinary hookup wire—should be used for this antenna. The insulation should match the

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73 Review

Number 52 on your Feedback card

The Hamtronics TD-4 Selective Calling Unit Kit

A tiny package of fun!

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In general, ham radio operators do just about everything with their radios. If a mode exists, there's a ham somewhere using it. However, one of the most interesting modes of radio operation also happens to be one that most hams know little about. That mode is the field of radio telemetry—the process of measuring and controlling values and processes via the radio waves. This mode is a little less understood than most, perhaps because the equipment necessary to implement it is fairly expensive and more complicated than simple voice gear. Also, the commercial market sources of used telemetry equipment are somewhat tighter than for voice radios, because less of this equipment is in use. So what does the ham who's interested in remote control do to learn more about this facet of ham radio?

The answer, as usual, is to build it yourself. An excellent product to start with is the Hamtronics TD-4 Selective Calling unit. The TD-4 provides a means to decode a four-digit DTMF tone, and use it for a single task. For the average ham, this represents the easiest way to perform a remote control operation. Since you probably already have a DTMF pad on one of your rigs the encode half of the system is set up. All you need is a receiver to hook the TD-4 up to, and you can use it to turn on or off anything, as long as you're within range of the radio. What you do with the output of the TD-4 is up to you—use it to open the garage door, turn on the lights, start the coffee, disable the local repeater, fire up the autopatch—it really doesn't matter. As Archimedes said, "Give me a relay closure and I'll move the earth." The hard part is getting that initial closure, but the TD-4 makes it easy and inexpensive.

Possible Uses

Before we get into how the TD-4 does its job, you may want to note that it's actually called a Selective Calling Unit. This controller was designed to mute a receiver speaker until a certain series of tones was received, at which point it would open the speaker and let the radio operator hear the message. That is identical to the operation of fire department pagers and monitor receivers, and can be used in the same way by hams. If you're tired of listening to chatter on the local repeater, just install the TD-4 on your base station. Give the four-digit code to your buddies, and have them call you by keying the repeater and dialing in your code. (Of course, you won't pick a code that will mess up the autopatch, and you need to know how to get the tones to pass through the repeater.) The Hamtronics unit will hear the code, decode it, and open your speaker. Carry on your conversation, and hit the "reset" when you're finished.

"All you need is a receiver to hook the TD-4 up to, and you can use it to turn on or off anything, as long as you're within range of the radio."

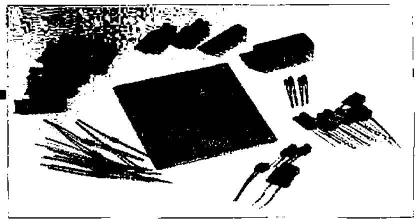

Photo A. The Hamtronics TD-4 board and components awaiting assembly.

A good application, but not very exciting. Why not install the TD-4 on your local repeater, and use it to detect "911" calls? If it hears one, have it start a tape recorder that will run until the patch drops, in order to record the call for training and liability purposes. (Does your state require the beep every 15 seconds?) How about a remote controller for that foxhunt transmitter? Turn it on or off as the hounds get closer. More diabolically, use the controller to raise and lower the power level.

The list of applications is limited only by your imagination. In any case, the controller will decode up to four DTMF tones in a sequence, and uses a set/reset latch arrangement. The first three tones of the *on* and the *off* sequences will be identical, and the last digit will determine whether the latch is set or reset. In other words, you can set up the decoder outputs to make a code of 123A to turn something on, and 123B to turn it off.

How It Works

So how does the TD-4 do it? All the circuitry is performed by four integrated circuits, with most of the work done by a G8870 DTMF decoder. This chip was originally designed for central office decoding applications, and takes care of all of the DTMF signal processing and decoding. It can accept a signal level from 100mV to 2V p-p, so no external audio signal conditioning is required. Valid DTMF tones are passed from the G8870 as hex digits to a one-of-16 decoder. Output lines from this decoder are jumpered to

a series of AND gates, which ensure that the tones are in the proper sequence. The final tone is used to "steer" the output of the prior AND gate to either the SET or RESET input of a simple latch. The output of this latch drives a single open-collector transistor, which controls the output of choice.

Kit Assembly and Documentation

The TD-4 is built on a high-quality glass epoxy double-sided circuit board, using plated-through holes. All jumper and input/output leads are marked on the board. The components are high quality, clearly marked, and easy to install. IC sockets are provided for all chips, making future troubleshooting a breeze. Due to the capabilities of the 8870 IC, the TD-4 decoder does a lot of work with just a few chips. This keeps the component count low, making it an ideal kit for the first-time builder. In addition, the circuit is so straightforward that even an inexperienced troubleshooter should be able to locate and correct any wiring problems.

The Hamtronics documentation is refreshing. The schematic and parts layout diagram are well done, and simple to follow. The instructions are clear, but assume that you've got a little intelligence. You won't find any of that "Insert left end of R1. Now insert right end of R1." stuff in this manual. As a matter of fact, the manual is nine pages long, and the entire construction section takes up about one-third of one page. So what's on all the other pages?

Well, useful stuff. Information on how to test the thing once you've built it. An explicit section on how to set the jumpers to program different codes. How to hook the decoder up to your radio. How to drive a relay, without blowing up the output transistor. Detailed selective calling applications. A serious troubleshooting section. And best of all, modifications. Not too many kit manufacturers give you the information you need to start hacking right off the bat (OK, so they call it *customizing*). They even give detailed instructions on how to convert the TD-4 into a "LiTZ" (long tone zero) decoder, for use on the nationwide repeater emergency

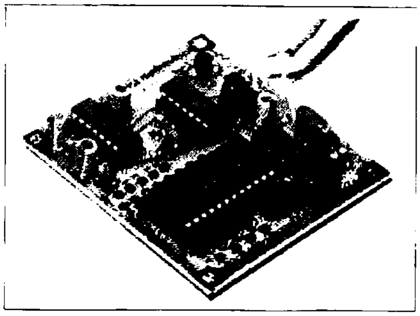

Photo B. The completed TD-4 board, just prior to installation of the programming jumpers.

system. In any event, the manual for the TD-4, while somewhat lacking in photos and drawings, treats the builder as if he or she knows something about electronics, and wants to learn more. More manuals should be like this one.

While Hamtronics gives the builder information on how to modify time sequences, etc., they don't get into any serious hacks, and the TD-4 is just asking for some. If you don't need the single function on/off arrangement provided, a couple of relocated jumper wires will allow the controller to provide pulses to two separate devices, allowing you to pulse on either of two timed functions. Need more functions? Hamtronics doesn't give you any more room on their circuit board, but considering that additional AND gates go for about 50 cents, why not add on an auxiliary board to give you a few more options? By duplicating the existing AND gate circuitry on another PC board you can control as many functions as desired. (Why not set up that foxhunt transmitter for on/off, high/low power, and even flip the frequency 5 kHz in either direction? *That* should keep 'em on their toes.)

As we said, the Hamtronics TD-4 is a great way to get into remote control with a single function, but it also provides a neat base for future expansion. Remote control applications haven't been fully explored by most hams, but equipment like the Hamtronics TD-4 makes experimentation easy. Compatible with gear that most hams already have, the TD-4 is a good entry-level project for the beginning remote control enthusiast.

"The circuit is so straightforward that even an inexperienced troubleshooter should be able to locate and correct any wiring problems."

HAMSATS

Amateur Radio Via Satellites

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AMSAT's (the Radio Amateur Satellite Corporation) newest and most complex satellite, Phase 3-D, is scheduled for launch later this year. Check out the article "Into Orbit With the Final Phase 3 Satellite" in this issue. Even with a few schedule slips, the event is less than a year away. In preparation, this month starts a series of columns for the newcomer to this fascinating segment of the amateur radio hobby. It will take time, information and energy to get ready for Phase 3-D, but there are several easy steps that can get a potential enthusiast on line with the OSCAR (Orbiting Satellite Carrying Amateur Radio) program.

Getting Started

You may already have everything you need to join in the fun on the amateur-radio satellites. It is a common misconception that satellite chasing is expensive and only for the technically elite. Even if your only "rig" is a 2 meter handie-talkie or a shortwave receiver, there are signals from space that you can monitor right now.

If you have a computer (most hams do these days) the chore of knowing when to listen for an OSCAR becomes a simple task. Many programs are available to find and track the satellites.

If your only antennas are attic dipoles or omni-VHF types, it's easier than you think to get involved. Some hams have only mobile and portable systems for their hamsat pursuits and still do remarkably well.

Finding detailed information about the ham satellites used to be a significant chore. Today that's not the case. Many books and articles have been written covering the myriad facets of satellite work. Some may be found at well-stocked bookstores or ham radio distributors, while others are only a phone call away.

2 Meter Downlinks

Satellites that provide 2 meter FM downlinks are very easy to copy with only a handie-talkie and an omni-directional antenna. Although the typical "duckie" antenna will work, one that has at least zero-dB gain (a quarter-wave whip) is better. Set the frequency of the HT or other 2 meter receiver (a scanner will do) to 145.825 MHz. Two satellites, U-O-11 and D-O-17, use this downlink frequency for their telemetry and digital message outputs.

UoSAT-OSCAR-11 was launched in March 1984. Built by the University of Surrey in England and launched by NASA from the Western Test Range in Lompoc, California, it is still operational today, sending 1200 baud ASCII data using Bell-202 compatible tones. The power output is only 400 milliwatts, but from a polar orbit of 680 km, this low-power signal can be heard with ease when the satellite is above the horizon. For most locations, four to six passes per day (about 10 to 18 minutes each) can be monitored. The satellite is also capable of limited digital speech using a National Semiconductor Digitalker chip set. Short messages are occasionally programmed by the ground-control station in Surrey.

DOVE-OSCAR-17 was sponsored by AMSAT-Brazil, but was designed and constructed by AMSAT North America (AMSAT-NA). Launch was on an Ariane 4 from Kourou, French Guiana, in February 1990. DOVE is an acronym for Digital Orbiting Voice Encoder. Although it is capable of complex voice synthesis, it normally transmits packet telemetry at 1200 baud with up to 4 watts of output power. A standard packet-radio TNC (Terminal Node Controller) can be used to view the messages and telemetry from D-O-17. The polar orbit is slightly higher than U-O-11, at 800 km, and can also be heard between four and six times per day.

Another source of signals from space comes from the Russian *MIR* space station. Many ham radio experiments are being tested from *MIR*, but the most popular activities include voice contacts with the cosmonauts and packet operation from the on-board PMS (Personal Message System). Voice and even SSTV (Slow-Scan TeleVision) can be heard on 145.550 or 145.800 MHz. Packet operation is typically on 145.55 MHz. RØMIR is the most common callsign sent from MIR.

10 Meter Downlinks

The two most popular satellites with 10 meter downlinks include RS-10, launched in June 1987, and RS-12, launched a few years later. The signals from these Russian hamsats are not FM. They transmit CW telemetry and act as communications transponders for CW and SSB signals. The satellites are controlled by RS3A in Moscow and are in polar orbits at about 1,000 km altitude. Even though power output is only 1 watt, both can be heard on a typical shortwave receiver with a simple dipole.

RS-10 transmits its telemetry on 29.357 MHz. The transponder downlink range is from 29.360 to 29.400 MHz. During a typical 10- to 20-minute pass, CW and SSB conversations can be monitored in the 40-kHz wide transponder passband. The stations heard are sending their signals to the satellite on 2 meters. The uplink passband goes from 145.860 to 145.900 MHz. Most RS-10 users only need about 25 watts to an omnidirectional base antenna to get into the satellite.

RS-12 telemetry can be heard on 29.407 MHz. The transponder downlink range extends from 29.410 to 29.450 MHz. The uplink, however, is on 15 meters from 21.210 to 21.250 MHz. While many stations using RS-12 employ newer 100 watt transceivers that can transmit on one band (15 meters) and then receive on another (10 meters), it's not uncommon to find QRP (low power) stations employing very simple transmitters running only a few watts on the uplink and inexpensive 10 meter rigs on the downlink. Dipoles in the attic on both the uplink and downlink bands will work with RS-12.

Tracking

While it is possible to set up a receiver and wait for a satellite to come by, it can be frustrating. The easiest way to find the hamsats noted above is to use a computer and a good satellite tracking program. Many programs can be found on BBSs (telephone Bulletin Board Systems) or via the Internet (ftp.amsat.org or http://www.amsat.org) as shareware or freeware that will perform the basic function of providing dates and times of the passes over a specific ground location. There are also companies and organizations like AMSAT-NA that sell software packages for most popular personal computers. Some programs provide real-time maps and coverage projections in addition to tabular time and antenna-pointing information.

Information Sources

Columns and articles dealing with hamsats have appeared in all the major ham-radio magazines since OSCAR-1 was launched in 1961, but for the newcomer, some good reference books provide more perspective. The suggested titles below can be purchased through AMSAT-NA. Write to AMSAT at 850 Sligo Avenue, Suite 600, Silver Spring MD 20910-4703, or call (301) 589-6062 to get the latest prices and information about membership and other publications.

1. *The Satellite Experimenter's Handbook*, 2nd Edition (1990; ARRL, 350 pages) by Martin Davidoff K2UBC.

2. *How to Use the Amateur Radio Satellites*, 5th Edition (1995; AMSAT, 32 pages) by Keith Baker KB1SF.

3. *The RS Satellites Operating Guide* (RS-10/11; RS-12/13 and RS-15), (1995; AMSAT, 30 pages) by G. Gould Smith WA4SXM.

This month was an overview. Next time, and in the months to follow, specific topics about the high-orbit satellites, rigs, antennas, coax, Doppler shift, Faraday rotation, the digisats, and many more facets of the hamsat chase will be investigated.

A Stealth 40-10

Continued from page 50

wall/ceiling color. A stapler can be used to secure the wire in place so it will be practically invisible.

This antenna is fed at the center, and the center insulator can be a button, a short length of nylon fishing monofilament, or any other insulator which will be difficult for anyone to notice. Twin lead or RG-8X coax can be used as the feedline. It should be brought straight down to floor level before being routed to your operating position. The feedline can be painted to match the wall color. A stapler can be used to secure twin lead to the wall. Coax can he held in place by a few painted cable clamps.

Cut the antenna wire a little long so you can prune it to the frequency you

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Number 56 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

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I love gadgets. I'm not afraid to admit that. After all, in this crazy hobby of ours it's an affliction that insinuates itself into our very fiber. This month, let me tell you about a new toy that can breathe new life into many forms of digital communication.

For a tad under two hundred dollars, I got the "Snappy Video Snapshot" from Play, Inc. For that money, you get the digitizer itself, a battery, cable, and three software packages. One of those runs the unit, but the other two are nifty graphics manipulation packages; more about them later.

Physically, the Snappy device looks like a fat candy bar with a DB-25 plug on one end. It plugs into the parallel port on your PC compatible computer, which needs to be at least a 386 running some flavor of Windows©, with 4 Mb of RAM and 4 Mb of free space on the hard drive. Video may be supplied "live" from the video output jack of almost any camcorder or VCR.

Once you load the software, you are able to "snap" a picture from moving video, or take a longer exposure, with higher resolution, from still video. The results are truly amazing. Photo 1 is a picture of the Snappy unit, taken with my VHS camcorder and digitized. The picture was then saved as a TIFF file, sent to 73 electronically, where it was placed onto this page. Neat, huh?

As I said, the source can be a live camera or VCR, and the "shutter" speed can be set to stop a moving video, or progressively longer exposure for higher quality with non-moving images. Image size may be scaled at 320x240, 640x480, which is full screen VGA size, or an astonishingly beautiful 1500x1125, all saved as 24 bit true color files, even on a monochrome machine. That last option does take up a bit more disk space, of course.

Now, if just snapping video is not enough for you, the two packages which accompany the digitizer are really something. For me, the more useful of these is Fauve Matisse, a graphics manipulation and drawing package which allows the creation, editing, and alteration of images from the Snappy Video Snapshot, along with other sources. It accepts and saves images in most of the popular formats, such as JPG, BMP, EPS, GIF, PCX, TGA, and a few others. You can retouch photos, produce comic shots with switched heads, or use the tools to paint pretty pictures, as my nine-year-old does.

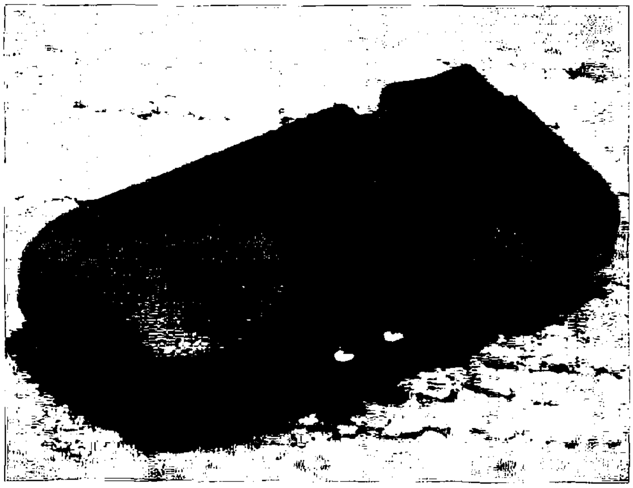

Photo 1. Pretty neat, huh?

The other program, not as useful to me but you might like it, is Gryphon Morph, one of the classic programs used to "morph" or change one picture into another. Starting with one photograph, key points are identified and corresponded to points on another photograph. The program then generates intermediate images which effectively change one into the other. The results can be astounding and fun to watch.

For the money, this is really a neat way to generate the digital images that are becoming necessary in electronic communications. While you may be inclined to get a scanner, they are typically more expensive, and can only copy flat objects. With the Snappy you can digitize your kids! Now, to be honest, there are a few glitches. Because it uses your parallel port, you cannot print with the Snappy installed unless you have two parallel ports or print to a serial port or network printer. I use an A/B switch to select the Snappy or my printer. The quality is good, but a 1200 dpi scan of an 8x10 photo on a thousand dollar scanner may be better, albeit for more money and a slot on your motherboard for the interface card. As the saying goes, "You pays yer money and takes yer choice."

To help you decide if the Snappy will fill the bill, Play, Inc., has a web site at: http://www.play.com where you can read a bit more and download a slide show of Snappy images. You will need a SVGA screen for the demo, but it is worth a look. Let me know what you think. If you get a Snappy, use it to take pictures of yourself and station, and send them to me by E-mail. Who knows? You might just see yourself here in RTTY Loop!

As long as I'm on the subject of "high tech," this month's web find addresses the cutting edge of packet communications. Mike Curtis WD6EHR, has placed a "9600 Baud Packet Handbook" at: http://inss1.etec.uni-karlsruhe.de/~df0uk/96man2.txt. This handbook for K9NG protocol 9600 baud packet addresses the questions raised by those inclined to exceed the 1200 baud speed barrier, without wanting to hear "But Cap'n, it canna go that fast without breaking up!" Take a look, it's an interesting work.

As I write this month's column, last month's column announcing the RTTY Loop Home Page, at: http://www2.ari.net/ajr/rtty/ has yet to be printed, and yet we are averaging about a dozen or so hits a day. I don't know where these folks are finding out about the page, but I anticipate the count will be much higher by the time this column sees printer's ink. On the home page, I have several past columns, with current ones as well, a full listing of the RTTY Loop Software collection, interesting ham radio related links, along with a few other strange sites, and a few things for direct download. Take a look, tell your friends, and drop me a line.

For those not online, the full listing of the RTTY Loop Software Collection may be yours for a self-addressed stamped envelope, sent to the address at the top of the column. E-mail may be sent to me via the Internet, at: ajr@ari.net; on America Online at: MarcWA3AJR; or on CompuServe at: 75036,2501; although that may be a bit simpler as well by the time this is published.

I'm accumulating quite a few cards and letters from some of you, with which to fill the April basket. Don't miss next month's column, when I shower you with answers.

NEVER SAY DIE

Continued from page 48

seriousness of the international situation, to try and work with him toward saving the hobby at the next conference. He told me to go to hell. Well, actually, that was what he meant, only he didn't use nearly as polite words. He explained that he had been running amateur radio for years all by himself and he would continue to run it, and I could go...well, you know.

Some hams in the State Department put on the pressure and I was

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Number 58 on your Feedback card

Ham to Ham

Special Six-Month Anniversary Column

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"Ham To Ham" is in its sixth month of life within the pages of *73 Amateur Radio Today* and the tips, suggestions and ideas keep coming in...good ones, at that. Uncle Wayne and I had originally given the column six months to get off the ground, to see if it's what the readers want, and we've made it! Please keep the ideas flowing this way. It's your column; I'm acting as intermediary, putting all the ideas into one place and editing the text for uniformity, but it's an open forum for everyone to share. In celebration of the six-month mark, the column is a bit longer this time, to give you more of the information you've said you want, and as a "thank you" to the many who've sent in contributions. Thanks also to Uncle Wayne Green for providing the forum.

By now you are able to see the direction that the column is taking, so you'll know pretty much what we're looking for. But even if you'd like to see it take a somewhat different avenue, send me your favorite tip and let me know what direction you feel the column should be moving...I'll try to keep an open ear for any serious suggestions for improvements.

Poor Solder Joints

I've personally run into a number of poor solder joints in well-known commercially-made ham gear, and I know others have, too. The solution in all of these cases was to reheat, and perhaps rewet, the offending connection. Rewetting a solder connection is just another way of saying "put a bit of new solder on it as the connection is reheated." If the connection looks mottled (marked with spots) or lumpy and dull, then removing the old solder with wicking-braid or a "solder-sipper," and applying all new 60-40 solder to the connection is the answer.

Just because a radio "came that way from the factory" doesn't mean that it was made perfectly. Here's part of the reason: between any two copper connections, such as the copper foil pad on a PC board and a copper wire or component lead attached to a board by a solder connection, there are: 1) the copper foil pad, 2) an alloy layer, 3) the solder mass itself, 4) an alloy layer, and 5) the copper component lead or wire. This is true of every good solder joint. If something happens to prevent that alloy layer from forming at either copper junction, or if it degrades with time, then a high-resistance or intermittent solder connection is the result.

One cause of a defective alloy layer is movement during the "plastic" phase of the solder cooling process ("plastic" meaning capable of being altered or changed). As solder goes through the liquid (melted) state to the solid (hard) state, in all but one solder formulation there is also a plastic-state temperature range. The length of time of the plastic state will vary with the respective amounts of tin and lead in the solder you're using or reheating. As an example, at the extreme end of the formulation scale there is 90-10 solder, 90% tin and 10% lead. 90-10 has a 700°F plastic range, between approximately 4300°F and 3600°F. Any movement of either of the pieces being soldered during that cooling range will result in a poor solder joint.

At the other extreme is 10-90, 10% tin and 90% lead. Its plastic state is from about 5800°F to 4400°F, or 1400°F of cool-down range, when the solder is still plastic. Movement anytime during this plastic state results in what's commonly called a cold solder joint. Insufficient heat at the joining of the two copper pieces during soldering can cause the same condition. To make a good connection, the solder must go far enough into the liquid range, drop down through the "plastic" range, and then enter the solid range without movement. And those two good alloy layers must exist for the lowest-resistance electrical connection to exist. If more than two wires or component leads meet then a good alloy layer must exist between each and the rest of the solder mass forming the connection.

Most of us use 60-40 solder, 60% tin/40% lead, because it has the best "wetting" characteristics. That also helps to provide a good alloy layer. 60-40 only has a 90°F or so plastic state, from 3700°F to 3610°F, so it's also helpful from that standpoint. There is a 63-37 solder formulation, 63% tin/37% lead, that has virtually no plastic state. It's called eutectic solder because the liquid-to-solid state is direct; that's the eutectic point. But that's the *only* formulation that skips over the plastic state.

Another reason why the alloy layer may not form properly is oxidation on either of the two copper parts, or some foreign substance on the parts that doesn't allow proper wetting and flowing of the solder. That's the prime reason why parts should be bright and clean-looking, and why only solders containing rosin flux should be used on electrical connections. The rosin flux, in the solder, or applied externally via soldering paste or liquids, is not a part of the connection itself. It "floats" the surface oxides from the two copper pieces and holds those impurities in suspension until the joint is alloyed. Remnants can then be cleaned away with a flux remover.

So why would a factory-made rig have poor solder joints? Perhaps the parts weren't clean enough when assembled onto the boards, or the board itself was contaminated. Perhaps there was some movement of the parts during the plastic stage of the cool-down period, perhaps not enough heat penetrated to the two copper connecting metals, perhaps the flux used wasn't doing its job, perhaps the solder formulation was off-specifications...any of these situations is possible. The issue is less "why" and more "where," since finding and fixing the poor connection(s) is the job at hand. Knowing why the factory-made connection failed is more academic than pragmatic once a piece of equipment is in our hands.

There are a couple of other caveats in soldering, though admittedly one may not run into them often. The first concerns a connection's heating as large amounts of current pass through it. All solder joints have some amount of finite resistance, but it becomes important when a connection must handle higher currents, such as in a high-power linear's plate tank circuit; the solder connection can actually soften or melt if special precautions aren't taken. A higher melting point solder would be a 5-93.5-1.5 formulation: 5% tin, 93.5% lead, and 1.5% silver. This formulation raises the solder's melting point to about 6000°F. Another special situation exists when soldering silver-plated components. To prevent the silver-plating itself from migrating, a high silver formulation solder can help. 96-4, which is 96% tin and 4% silver (no lead), will prolong the "wetting" time before silver migration takes place. It requires a higher melting temperature, about 4300°F, but provides a stronger connection. Radio Shack™ carries this under their part number 64-025.

Easy Backyard Coax Cable Protection

From Ken Guge K9KPM of Lombard, Illinois: With spring not too far away, here's an easy-to-implement tip for protecting a surface backyard coax cable from pedestrian damage and lawn-mowing hazards:

"When I originally installed my 40-meter horizontal wire dipole antenna in my backyard, the center-feed coaxial cable ran down the trunk of a large tree, across the grass to the house, and then through a small hole in the above-ground portion of the basement wall. Wanting to protect the coax from people walking on it, as well as from other yard activities, I made a simple three-sided wooden cover to lay over the top of the cable. It worked for a while, but keeping the wooden cover looking good with paint and, more importantly, keeping it from rotting underneath, became a too-often-avoided task!

"While browsing through an office supply store one day, I spied the cable protection strip material used in many offices to hide across-the-floor cabling, and I immediately visualized it protecting my backyard above-ground coax instead. One brand goes by the name SL Waber Cordgard®, and is usually available in 6-ft. or 15-ft. sections. It's a rugged vinyl casing that covers the entire cable, and has a curved top surface that helps to prevent tripping, if someone doesn't happen to notice it running across my yard! Just as important, it requires absolutely no maintenance and should last for a number of years, even outdoors, before a replacement might be needed. It's a big improvement over the wooden cover that I was using before, from the standpoints of protection for the coax, pedestrian safety and appearance."

Good application, Ken. The same type of product could, of course, be used in the ham shack itself, if a cable or two are needed on the opposite side of the room from your ham station operating position, providing the same protection and safety Ken has found it does outdoors. It could also be run up a wall if a cable "drop," either indoors or out, needs to be hidden.

Extending the Fun

From Mike NØALJ of Rogers, Arkansas: Wire yourself into your hobby without having to stay in the shack.

"Here's an idea I've used to enable me to enjoy my various radios in places other than my ham shack. I've set up a speaker in the garage so that I can listen to my favorite ham bands while I'm working on my HO train layout there. I've also extended a speaker out to the patio deck, so that I don't miss anything when relaxing in the open air or working around the yard. I've also found that in the ham shack itself a local extension speaker there can enhance the sound significantly.

Sure Seal for Outdoor Connectors

From Bill Thim N1QVQ of Broad Brook, Connecticut, try this tip for permanently sealing outdoor connections, such as those that might be used for coax, power, control cabling, etc.:

"I recently had some work to do on my well and came across a power cable splicing scheme that could also be useful with coax and other types of cabling used for outdoor ham antenna work. Some home improvement centers (Home Depot, in this case) sell a splicing kit for submersible pumps that is truly watertight when used as directed. After the splice is made electrically sound, the connection point is coated with a silicon-type sealant, then a six-inch-long section of heat-shrink tubing is carefully slid up the cable to cover the joint and sealant. When the tubing is shrunk with a small torch or heat gun, until the sealant can be seen oozing from both ends, you'll have a connection that defies the worst of the elements. The tubing supplied with the kit is large enough in diameter to fit over a PL-259 or SO-239, so it's just the ticket for ham antenna use as well. Once the process is completed, you'll have to cut the connection apart if you ever want to get into it again, because it is meant to be completely permanent!"

Good find, Bill. Read the cautions on the label before using any silicone-type of sealant on antenna and other connectors, though. Some sealants warn against their use directly on certain metals (in many cases, brass and copper). Perhaps wrapping the connection first with electrical tape, or a thin application of a flexible coax-seal product, to avoid direct contact with the metal, would offer enough protection to avoid the corrosive effects of some of these silicone-based sealants. Furthermore, if you are unable to locate the kit Bill mentioned, you might be able to purchase the essential parts separately. It's a worthwhile process to remember next time you need to waterproof antenna connections. Fast-setting epoxy might work in place of the silicone adhesive, but it wouldn't have any flexibility when cured, and epoxy often cracks if subjected to mechanical strain.

An Emergency 12-Volt DC Power Distribution System

From Erling Gruel WB9OJD of Fond du Lac, Wisconsin: Looking for a nice layout for an uninterruptable, emergency 12 Volt DC Power system?

"Here's an idea that's reasonably easy to duplicate for those who don't have a gas- or diesel-powered generator to allow them to stay on the air during power outages. Emergency preparedness has been a long-standing traditional part of the amateur radio credo, and this solution is economical, straightforward and, I've found, very functional.

"I was mainly looking for a means of powering my 50-watt, 2 meter solid-state transceiver, a couple of scanners, simplex autopatch, CB radio, some limited lighting and an elapsed-time 12 volt DC automobile clock (or an interval timer/clock such as the Radio Shack™ #63-884) so that I know how long the emergency backup system has been running. Some of the newer 12 volt DC HF radios could also be powered from this setup if transmissions are kept brief or minimum power is used.

"The heart of my system is a wooden box, attached to the shack wall near my operating desk, approximately 8" high by 7" deep by 12" wide, that contains all the necessary metering, toggle switches, fuse holders and a four-pole, double-throw relay whose 12 volt coil is normally held up by an AC mains-powered 12 volt DC power supply. However, when the power fails, the relay drops and transfers everything normally powered by the station's 12 volt DC supply to the 12 volt DC backup system instead. A master cutoff switch disconnects the emergency backup battery if the relay de-energizes for some other reason, or if I turn off the main 12 volt DC station supply. The emergency backup battery is kept charged by a continual constant-voltage trickle charger during the norm, when commercial power is available.

"I've also extended the battery supply leg of the system into my garage so that if the ham shack backup battery runs down I can quickly and conveniently utilize my car's battery to keep the equipment going! The car, of course, can be started and backed out of the garage ahead of time, so that it will supply charging current to its battery, giving me virtually endless power....at least until the car runs itself dry!

"From the garage to the basement ham shack, I used heavy Romex cable to keep the losses as low as possible, and I've terminated the cable in steel electrical boxes at each end, clearly marked as being 12 volt DC only. I have a cord and connector coming directly from my automobile's battery to the front grill, and an extension of this cable to get from the car's front grill over to the garage wall feed box. Whatever type of connectors you decide to use to implement the system, they should not be easily mistaken for any other purpose and should be husky enough to carry the current that you anticipate your particular system will draw under maximum usage.

"I found that a marine type of deep-cycle lead-acid battery works best for the basement backup battery. Not including the battery, the whole system cost me under $100 to implement...not a bad price for the extra sense of operating security that it provides. The drawing in Fig. 2 pretty well shows my own particular setup, but I'll be happy to answer any specific questions from *73* readers as best I can."

A 12 volt DC to 120 volt AC inverter could also be included in your system for powering 120 volt AC only equipment but, of course, that would up the final cost. Also keep in mind that in any system like this, everything should be made easily and quickly disconnected, clearly marked and neatly installed, so that in an emergency you'll waste as little time as possible having to figure things out! We all tend to forget the details if a system isn't frequently used. Making a diagram of the entire system, and posting it in both the shack and the garage, would be time well spent. Erling also mentioned that he's willing to supply more information to any reader having a sincere desire to duplicate his idea. It's nice when contributors are willing to help others in similar situations, so please be polite and appreciative of the free assistance...and always include an SASE (self-addressed stamped envelope) for a reply.

Editor's note: if you would like a wiring diagram of the Emergency 12-Volt DC Power Distribution System, please send a large business size SASE to "Wiring Diagram," c/o 73 Magazine, 70 Rte. 202 North, Peterborough NH 03458.

Editor's note: ***if you would like a wiring diagram of the Emergency 12-Volt DC Power Distribution System, please send a large business size SASE to "Wiring Diagram," c/o 73 Magazine, 70 Rte. 202 North, Peterborough NH 03458.***

SCR Testing Idea

From Herb Foster AD4UA of Melbourne, Florida: A suggestion for a simple method of SCR testing.

"In my experience working on RCA television receivers on a part-time basis, I've come across an easy way to determine the proper operation of any suspected silicon-controlled rectifiers in the circuit. It isn't hi-tech but it's worked for me every time! All you'll need to duplicate this method is a source of 12 to 20 volts DC, a digital multimeter, and a 470 ohm 1/2 watt resistor. If the SCR happens to have a PIV rating of less than 12 volts DC, use that lower voltage, but most will not be harmed by the 12 to 20 range specified.

"Completely remove the SCR from its circuit, connect the 470-ohm resistor in series with the device's anode lead, then to the DC power source. The sample diagram in Fig. 1 shows the test circuit schematically. Connect the cathode of the SCR to the minus of the power source. Clipping the digital multimeter across the resistor, with the power source tuned on, there should be no voltage drop across the resistor because the SCR should not be conducting (or leaking). Now connect the gate of the SCR to the anode just momentarily. The meter should read a 1- to 3-volt DC drop across the resistor if the SCR is conducting normally. Momentarily disconnecting the SCR's anode from the source voltage should again cause the device to stop conducting.

"This simple test effectively checks the SCR for opens, shorts, leakage, and the ability to fire normally and latch up, then return to its static state when the anode is momentarily opened...all you'll need to know about it. If it passes this test, then without question, it's good."

Herb has submitted a couple of good ideas to this column. Here's

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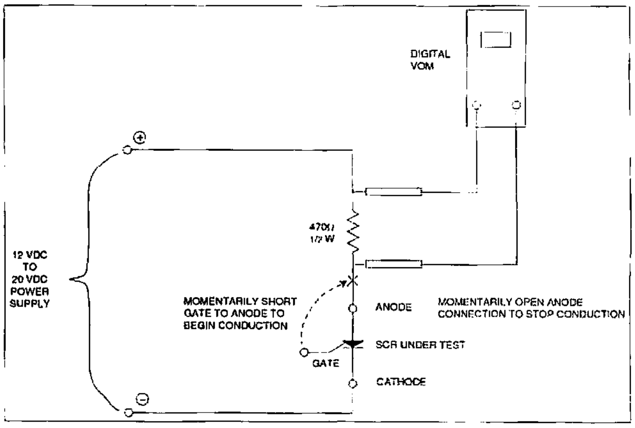

Fig. 1. AD4UA's simple SCR test circuit.

Number 62 on your Feedback card

Low Power Operation

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More Century 21

Remember where we left off last month?

Inside the power amplifier of the Century 21 you'll find four active devices: two drivers and a pair of final transistors. Looking inside the PA compartment of my unit, it became quite clear to me that I was not the first person to visit. It seemed that at one time, or more, the two final transistors had been replaced. In fact, the solder pads for one device had been lifted from the Fiberglas board.

The two final transistors are MRF475s. They are available from Ten-Tec for about $5 each. I'm sure you could get the replacement parts from Digi-Key or Mouser; both stock the NTE replacement series. I don't have a recent copy of the NTE replacement guide, so I don't know the proper NTE replacement number.

Both final transistors are insulated from the heat sink by a mica insulator and hardware. If you have to remove one of the finals, don't lose the hardware; you'll need it when installing the new devices.

Repair Work

Since I had no idea which one of the finals produced all the smoke, I decided to order a pair and install them both. To remove the final transistors from the Century 21, start by removing the hardware securing the device to the heat sink.

Now, carefully unsolder the wires from the larger transformer and bend them out of the way. You have to do this so you can gain access to the transistors. There are two 2 watt resistors also connected to the transformer's leads. Unsolder these as well and push them aside for now.

Next, you'll need an extra heavy duty soldering iron to unsolder the emitter leads from the ground plane on the circuit board. I find it easier to grab hold of the emitter lead with needlenose pliers and gently pull up on the lead while applying heat from the soldering iron. There is not much room to work with desoldering braid. Do the same for the base lead, but be careful you don't pull up the copper pad from the board. You can now lift the device out of the PA compartment.

Installing the new transistor is a bit easier. First, take your soldering iron and smooth out any rough spots on the PC board where the emitter lead will go. Do the same for the base lead as well. You want these two connections to be as flat as possible to ensure good contact with the ground plane. The emitter lead must be soldered as close to the ground plane as possible.

"The mixer worked and had output on all bands."

After you have prepped the areas to be soldered, put a glob of thermal goo to the heat sink and install a new mica insulator. Just in case the hardware is beyond use, Radio Shack™ sells a TO-220 mounting kit, complete with insulators and mica washers for about a buck.

Adjust the leads of the transistor so they match the PC board. Now, tighten down the hardware. Check to see if you have the transistor twisted in such a way as to short the tab (collector) to the ground plane on the PC board. After you have check one more time for alignment, solder the leads down. Installing the transistor this way prevents adding stress to the body should you install the transistor slightly off square. Finish up the job by installing the other transistor.

As a precaution against cooking the power supply, check the collector of each transistor for continuity to ground. Do this *before* you finish reinstalling the various transformers. If you have a collector shorted against the ground foil, it's best to fix it now.

After replacing the finals, I attached the PA to the back of the Century 21. I then attached all the interconnection cables and applied power to the rig.

At key down, the RF drive was slowly increased until the output meter began to show and increase. For a few seconds, I had about 40+ watts of RF output, until the smoke came billowing out of the PA compartment once more. Now, I don't know about you, but I really don't care for 40 meter CW with a smoke detector blaring in the background.

The first thing I thought of was the new finals going up in smoke again. However, after opening the PA compartment once more, I found the final transistors in good shape. The two driver transistors and their emitter resistors were history!

Replacing the drivers' transistors requires the same amount of work as replacing the finals. The drivers are in a smaller case and thus are a bit harder to get in and out of the circuit board. The driver transistors are MRF 472s.

Again, the drivers are not on the shelf at the local Radio Shack™ so another call to Ten-Tec was in order. The 1 ohm half watt resistors were made of carbon and not metal film. I ordered a handful just in case. Nothing was left of the originals except some burned leads and dust.

Since the drivers must be replaced, the driver bias must be

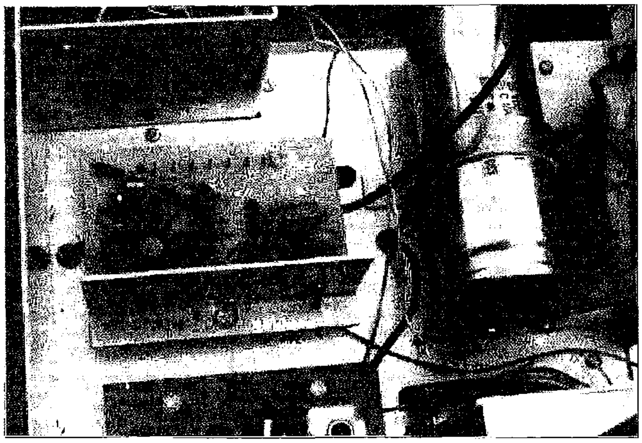

Photo B. The low level RF driver is mounted to a small heat sink. This board plugs into a chassis-mounted socket.

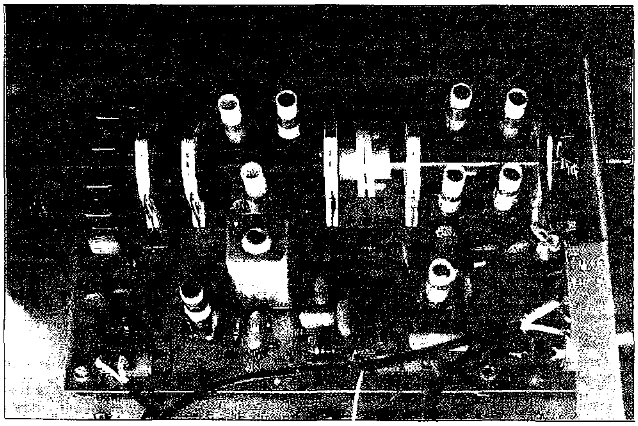

Photo A. The mixer/oscillator board contains most of the band switching components.

set. You accomplish this by inserting an amp meter in series with the +12 volt lead of the PA. You then apply power, and adjust the bias trimmer for about 6 mA.

One more time, the PA was reassembled and tested. On all bands, except 20 meters, I had 40+ watts.

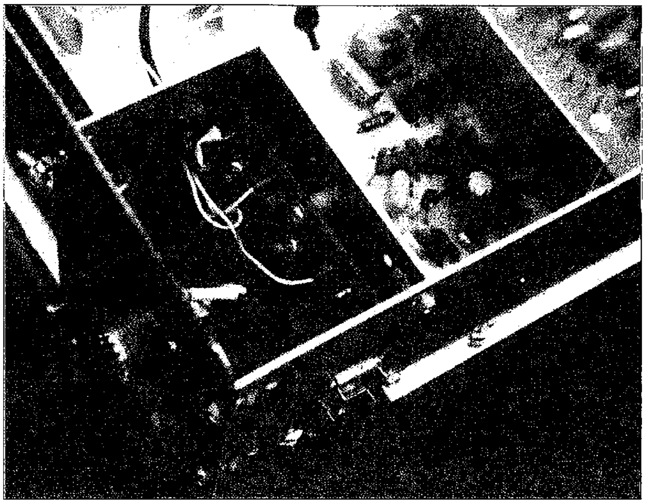

Photo C. Looking down inside the output filters. The driver can be seen sitting just behind the filter.

A Dead 20 Meter Band

The Century 21 mixes the VFO with an external signal provided by a separate heterodyne oscillator to produce the desired transmitter signal. This oscillator and its associated components are located on the 80358 mixer board. (Photo A).

The mixer uses a single MPS3563 transistor. A rotary switch selects the proper crystal according to the band selected. The output of the oscillator is then mixed with the incoming VFO by IC1, a MC1496. The out from the mixer is routed through a series of tuned circuits.

Since the oscillator is common to all bands, and every band worked except for 20 meters, I suspected that the 20 meter crystal was kaput. Checking the output of the oscillator with a scope showed plenty of oomph from all bands. The mixer worked and had output on all bands. That had to mean the signal was stopping someplace in the tuned circuit for 20 meters.

I've mentioned this before many times: Never start messing with alignment settings. But in this case, I did notice the slug of the 20 meter coil was at the very bottom of its core. With a scope, I adjusted it until I could see some output. The coil is fairly broad, so there is no peak to the adjustment. The mixer board also supplies the required signal to the receiver section.

That seemed to fix the problem on 20 meters. I never did connect the antenna to the rig, so I *may* have fixed two problems!

Since I had to tear down the Century 21 for most of these repairs, I decided to replace the spot and drive pushbuttons on the front panel. Ten-Tec no longer stocks replacements for these switches. They suggest a switch available from Radio Shack™, a 275-618 momentary contact type. You must remove the knobs, control nuts and front panel to get to the switch mounting clips. Since the spot switch was broken, I cut the switch clips with a pair of side cutters and saved myself some time.

"I found it a pain in the butt to wrestle with the speaker..."

I found it a pain in the butt to wrestle with the speaker while working on the Century 21. I added a small 156 header and socket so I can disconnect the speaker from the rig. The connector pair is made by AMP, but you need a special tool to crimp the wires. A trip to Radio Shack™ will yield a nice selection of AMP connectors which are easier to install.

There are two other items worth taking a look at. One is the offset balance control located on the control board. You can adjust this trimmer by listening to the pitch of the signal when the ZERO BEAT switch is closed. Adjust the trimmer so the pitch between the two conditions is the same.

The second check is the PTO. There are no adjustments inside the PTO that you should mess with. But do check the condition of the PTO shaft. If it is dry, apply a very light coat of lubricant. Don't get carried away; too much goop and it will end up on the display and inside the PTO.

The Century 21 by Ten-Tec is easy to work on. Its open chassis and plug-in boards are simple to remove and repair. In operation, the design is simple to operate. You can reduce the drive and run the 21 at QRP power levels. Or, if you're one who likes a change of pace, bypass the PA and route the low level driver directly into the filter stages. The driver should be able to do about a watt or so. 73

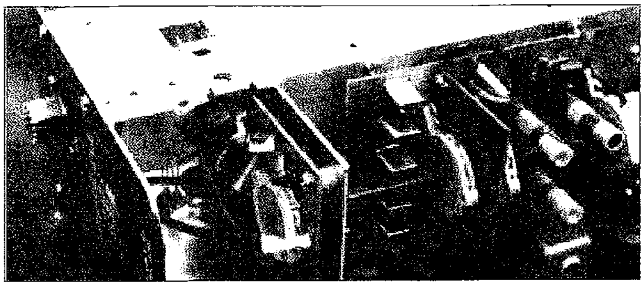

Photo D. Output filters looking for the bottom chassis. The mixer/oscillator board is behind the filter box.

NEVER SAY DIE

Continued from page 56

selected, in addition to Budlong, to represent the US at the 1959 world ITU conference in Geneva. When I got there I read through a three-foot stack of papers to find the proposals from the attending countries for the redistribution of the 3-30 MHz spectrum. It looked really serious for us. The ITU hams had been right on target. I attended the US delegation meetings, where I heard the delegates representing the other radio services promising to support the retention of the ham bands. But then, when I took them individually out to dinners to talk, I found that every one of them had confidential private instructions that if their service turned out to be in danger of losing any frequencies, the losses would be taken from the nearest ham band so as to prevent their service from any losses. Some support!

The only hope for saving the ham bands lay with getting the discussion for the redistribution of the 3-30 MHz segment to be postponed until the next conference, which was ten years away. The American delegation members got in touch with the other country delegates, trying to get support for this strategy. They got nowhere. After all, virtually all of the other countries had proposed either getting rid of the ham bands, or cutting them way back.

Finally, they put on some really heavy pressure and got The Netherlands to back us up. Thus, when the conference officially opened, The Netherlands representative got up and dutifully made a motion to put off the re-allocation decisions until the next conference. And, to everyone's amazement, the USSR representative got up and seconded the motion. Since he had a whole string of Soviet and communist countries in his pocket, that was the end of it.

Later I talked with one of the USSR delegates to find out what had happened. He explained that it had to do with Kruschev recently visiting the US and talking with Ike. The USSR wanted to show that they were being more friendly to the US, and thus, being the first international conference to come along, we were the winners. A few weeks later Powers' U2 was shot down over Russia and the frost was back on the US-USSR relations. Whew, were we incredibly lucky at that timing! We came *that* close to losing amateur radio in 1959.

I visited Budlong's hotel suit, again in the most expensive hotel in town. Luxurious! I stayed at a modest hotel, but once the main event affecting amateur radio was over I flew back home to work. Bud stayed on for the whole conference, flying many of the League directors over for lavish parties, all at the members' expense.

Continued on page 75

Number 63 on your Feedback card

Above & Beyond

VHF and Above Operation

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Lasers and Power Supplies

Last month I brushed lightly over several comparisons between microwave operation and laser operation. These factors included pointing dish alignment and laser beam accuracy. This month I want to expand on some of those ideas.

One concept I would like to make clearer is the comparison of microwave radiation from dish-type antennas to laser energy as emitted from a laser or optics system that collimates the laser beam. If we compare HF operation on 3 to 30 MHz to operation with a dipole antenna, our antenna pattern is bidirectional. If we change the antenna to a yagi-type beam for the same frequencies, it becomes quite large and cumbersome but does increase the forward radiation of power into a more directional pattern, say 15 to 20 degrees or less for a good system.

Now, if we were to increase the frequency to the microwave realm of 10 GHz and use a dish antenna 30 inches in diameter, this would limit our front radiation of energy to about 3 degrees of beamwidth. Now what does that mean if we are positioned remotely at a distance of 10 miles? Well, we can calculate the answer from the known fact that our angle is 3 degrees and our distance is 52,800 feet (10 miles). You have the top of a triangle and know its angle (3 degrees) and the distance (10 miles or 52,800 feet), making the base of this triangle the radiation hot spot at 10 miles of our dish antenna. The hot spot in this case is our triangle base of 2,767 feet—we can refer to this hot spot as the microwave *footprint* —so, the microwave footprint at 10 miles distance when using a 30-inch dish is about a half mile across.

How do you obtain gain at microwave levels, using this same scenario? Well, let's increase the size of the microwave dish from 30 inches to 48 inches in diameter and watch what happens to power antenna gain. When we increase the size of a microwave dish antenna to 48 inches in diameter, its radiation pattern is focused into a beam something less than 1 degree (that's 1/360th of a circle). What is the footprint at the same 10-mile distance of this arrangement? Its hot spot is about 921 feet, or one-third as big as our previous example, and there is a significant increase in power because it's condensed into a smaller area. Hence, the receiving antenna can capture more of the transmitter power, making for an overall power gain on the transmitter to receiver path. In actual practice, a 30-inch dish exhibits about 35 dB gain while a 48-inch dish has 40 dB gain measured at 10 GHz.

A general rule of thumb is: As frequency is increased, antenna gain also increases when the antenna size remains the same for each frequency. If the frequency remains the same, and the *antenna* is increased in size, there will be an increase in antenna gain.

How Does Microwave Compare to Laser Operation?

Let's look into the optical laser world and do the same type of comparison between a sample microwave system and a laser. What we are looking for is a handle on how difficult it is to focus a spot of light on a distant object. A laser would be focused into a beam much the same as microwave energy. As a matter of fact, the relationship is exactly the same—it's just that the laser is vastly higher in frequency than the microwave system. In this example the microwave transmitter operates at 10 GHz and the laser operates at 470,000 GHz or 632.8 nanometers. Its beam of light is dispersed or spread out approximately 1 millirad. Why did they shift gears and call beamwidth 1 millirad instead of measuring it in degrees? At light frequencies "degrees" is a very large number; millirads are parts of a degree, and more useful.

What, you say, is a millirad? Take my word that it's quite a bit smaller than 1 degree of compass bearings. *Everything* is smaller up in the optical and non-optical light world. Very low frequency operation is our power distribution system's 60 Hz. We all know where HF, VHF, UHF and our microwave SHF bands are. But even higher are the infrared, the narrow visible light spectrum we see, and the higher ultraviolet, X-ray, and Gamma ray spectrum.

> ***"The ignitor circuit is quite ingenious in its function: It's another voltage multiplier circuit, connected in series with the main power supply load."***

The laser's 632.8 nanometers (nm) falls in our visible spectrum, and while most lasers have a beam dispersal of about 1 millirad, how do we figure this in degrees?

We'll go through the math nosebleed again. Dividing 180 degrees by π (3.14159) equals 57.29577 degrees, or one radian. How many radians in 360°? We have $2 \times \pi$, or 6.28 radians in one circle. Check me out—divide 360 by radians. You'll get 1,600 mils in 90° or 6,400 mils in 360°; so in 57.29° (1 radian) there will be 1,018.6 mils. For our purposes, 1,000 mils in 1 radian is close enough. Now, if you factor all this out you'll conclude that a typical laser beam of 1 mrad (millirad) is about .05°. A quick calculation by comparison of laser to microwave beamwidth will show you that the laser is *60* times smaller than the beamwidth at 10 GHz using the 30-inch dish. That relates also to being about 60 times harder to focus the beam spot on a target when measured at great distances. See why we had so much trouble trying to place the spot on a target four miles distant? It took a good part of an hour to accomplish the task when the microwave aiming was done in seconds.

Now, let's look into what it takes to make up a laser power supply. See Fig. 4 for distance measurements comparing a VHF yagi to 30- and 48-inch dish antennas, and finally to a HeNe laser whose beamwidth is rated at 1 millirad.

Laser Power Supplies

A laser power supply to power a glass Helium Neon (HeNe) laser tube requires two power supplies to function. One supply is used to ionize the HeNe gas and the other is required to ignite and maintain the laser in its normal operational mode emitting a laser beam.

The ionization of the gas takes a very high-voltage, low-current pulse type of supply, while the ignition of this ionized gas requires a more stout low-voltage medium-current supply. Voltages for ionization are near 8 to 10 kV at extremely low current. The ignition supply must be capable of supplying about 1,000 to 1,500 volts of DC power at about 10 milliamperes. The intriguing thing about these two power supplies is how they are integrated into one package.

There are several variations, depending on input power requirements. For most industrial applications where there is AC power available, that is what is used. I have observed power supplies that have individual transformers with wiring feeding the

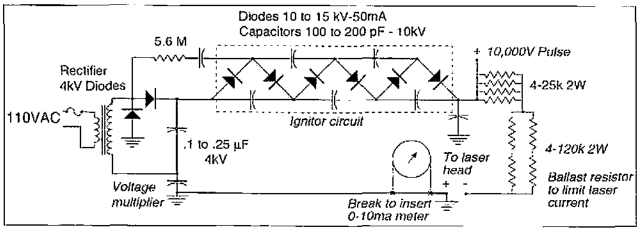

Fig. 1. Basic laser power supply showing rectifier, voltage multiplier, ignitor and ballast resistor circuit.

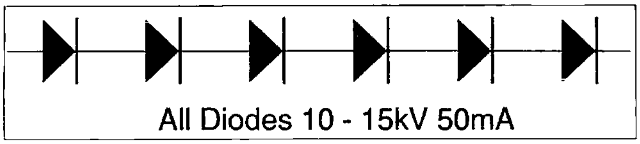

Fig. 2. Series diode rectifier before addition of voltage multiplication circuitry.

high voltage rectifiers and associated circuitry. This type of circuitry usually lends itself to easy component troubleshooting as everything is out in the open.

There are other types of supplies that have integrated all the materials, including the transformer, into a solid block of potting compound, making the unit a single-shot device. "If something breaks replace it" is the right motto for this unit. It does, however, offer reliability and is physically much smaller, making it very attractive (especially in surplus).

Power supply pricing for surplus devices of the open transformer type runs about $20 or less, whereas a similar potted unit can go up to $45 or so. It seems that they are the power supply of choice among power-supply scavengers. Another variation of the potted supply would be one that operates from low-voltage DC input (12 volts), converting the input 12 volts, through a switching supply circuit, to the higher voltage AC, then rectifying it for use. These are most desirable for portable use.

Power Supply Innards

The basic circuitry is varied but the basic type of circuit, in principle, is the same, high voltage of 1,000 volts at several mA of current, with a pulse of 10,000 volts to ionize the HeNe gas inside the laser tube. See Fig. 1 (basic schematic diagram for a laser power supply). As you can see, the circuit is a straightforward rectified AC transformer type of supply, except for the small circuitry attached in the positive lead that's connected to one side of the laser.

This circuitry produces the very high-voltage pulse at microamp low-current levels to ionize the gas inside the laser tube. Here is what is happening: The basic power supply circuit is a standard step-up transformer, feeding a diode rectifier and capacitor voltage multiplier, to produce a steady DC output of 1,000 to 1,500 volts. In series with the power supply is the ignitor circuit which connects to the ballast resistor circuit.

Three main components form a laser power supply: the high-voltage rectifier multiplier; the ignitor; and the ballast resistor circuit. Refer to Fig. 1 for the demarcation points for these three different parts of the circuit. The voltage multiplier portion steps up the input voltage from a low AC value to about 500 volts AC in the transformer. The diode rectifier converts it to DC and the voltage is further multiplied in the capacitor voltage doubler diode rectifier circuit to the 1,000 to 1,500 volt region.

The ignitor circuit is quite ingenious in its function. In fact, it's another voltage multiplier circuit, connected in series with the main power supply load (the laser tube and ballast resistor circuit). The ignitor circuit is constructed with a series string of six special very high-voltage diode rectifiers. See Fig. 2. Alone, these diodes in this configuration only provide a voltage drop across each diode junction, and reduce the power supply output by a few volts.

However, by adding small-value capacitors (100 pF), as shown in Fig. 3, to the series diodes changes the whole picture. We still have the small voltage drop across each diode, but during the period when the laser tube is in a static cold non-light-emitting period, drawing virtually no current, this network multiplies the power supply voltage from 1,000 volts to a pulse of high voltage near 10,000 volts.

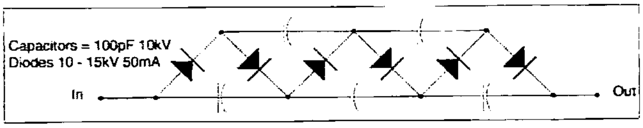

Fig. 3. Complete circuit of voltage multiplier used for laser ignition. Voltage required: approximately 10 kV.

The current that this circuit can furnish is minuscule in the microamp range but is enough to ionize the HeNe gas in the laser tube, allowing it to function with the lower-voltage DC power supply which furnishes current now conducted via the ionized gas in the laser tube. The ignitor circuit cannot supply voltage multiplication with any applicable current flowing, due to the very low value of capacitors and the efficacy of this high-order multiplier. When low voltage (1 kV) current starts to flow through the ignitor series diode circuit towards the laser tube load, the ignitor multiplier action ceases to multiply.

Blame it on the low capacitance of the 100 pF capacitors and the poor ability of the multiplier to supply any amount of current. Electronically speaking, it sort of disconnects and becomes just a series of high-voltage rectifier diodes. (I hope I haven't tripped over myself trying to explain the operation of the ignitor circuit while explaining its function.)

The last portion of the laser power supply is the ballast resistor, one or a series set of several resistors whose primary purpose is to limit current to the load. The load in this case is the laser tube whose gas is already ionized placing the tube in a conductive state. The ballast resistor will limit the current flowing through the laser tube to a safe level, as specified by the tube manufacturer.

How do you test a laser power supply (if you can get to the various parts of the circuit), and what type of meter do you use? Safety is *always* the foremost concern, so you want to use a testing setup that is suitable for operation at the highest voltage rating of the system, and that's 10,000 volts. I do not recommend trying to use voltmeters and DVMs that are in popular use today. I prefer to use an old RCA Voltohmist VTVM with a 50,000-volt high-voltage probe much like what you would use to check a TV CRT anode high-voltage circuit. Sure, it's yesteryear's circuitry, but for voltage in the 15-kV range it can't be destroyed and affords you, and the meter being used, a high degree of protection.

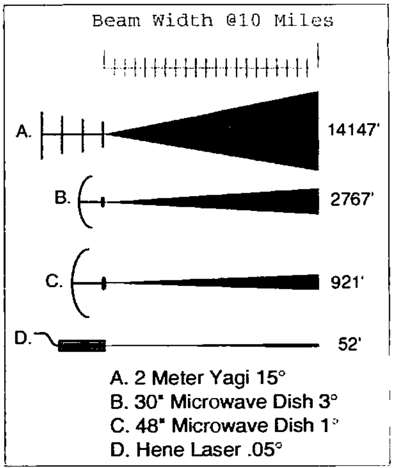

Fig. 4. Beamwidth comparisons between an HF or VHF yagi, a microwave dish antenna, and a HeNe laser. Beamwidth or spot patterns were measured at a target 10 miles distant.

I can't neglect to mention the basic protection and caution when working with lasers: *The voltage being used is deadly.* Precautions should always be taken to ensure proper grounding of all equipment, as well as insulating yourself against accidental contact with any of the high voltage circuitry. This equipment operates with high voltage in the 1- to 2-kV range and should *not* be treated lightly. Yes, it would be safer to employ solid-state laser diodes, as they operate on much lower voltages, but their biggest drawback is that they haven't become available on the surplus market at a reasonable price.

Well, that's it for this month. Next month I'll get into how to start a society or group of amateurs such as our group, the San Diego Microwave Group. I will get into the care and feeding of this group, and the projects that bind us together. 73 Chuck WB6IGP.

Number 66 on your Feedback card

Communications Simplified, Part 3

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So far, parts 1 and 2 have dealt with audio and video signals, respectively. Both of these have dealt with analog waveforms. In this part we discuss digital signals.

Digital Data

In its simplest form, digital data is simply a series of numbers. Those numbers could simply be data (such as some company's payroll records), or they could be a digitized analog signal (such as a digitized telephone signal.) As far as sending those numbers from one place to another, it doesn't really matter what these numbers represent, so we won't worry about that at this point.

Although we humans generally use decimal numbers, both computers and communications equipment use binary numbers. The most important reason is that these numbers are less likely to be misread as errors.

Suppose someone asked you to count the beans in a jar, but specified that you are not allowed to use any number that has a 2, 3, 4, 5, 6, 7, 8, or 9 in it; only numbers with a 0 or a 1 are allowed. How would you count?

Like any good computer person, you'd start with zero, and count

0
1

But now you realize you're not allowed to use anything from 2 through 9, and so you skip ahead to

10
11

Now you're stuck again. You can't write down 12, 13, or even 20 or 30 or 90, so you skip ahead to

100
101

Now you again have to skip ahead to

110
111

and now you must skip a whole series of numbers until you get to

1000
1001

and so on.

Congratulations. In writing down the numbers

0
1
10
11
100
101
110
111
1000
1001
1010

you have just invented the *binary number system.* Each of the counts in this table corresponds to one of the numbers of our decimal number system, as shown in Table 3-1.

Table 3-1

Binary	Decimal
0	0
1	1
10	2
11	3
100	4
101	5
110	6
111	7
1000	8
1001	9
1010	10

The decimal number system (from the prefix *deci*, which means 10) has ten different digits, whereas the binary number system (from the prefix *bi*, which means 2) has only two. These two binary digits are called *bits.*

Binary numbers are used because, with just two different digits, it's less likely that they will be confused. For example, in a typical digital circuit, the 0 bit might be something "near" 0 volts, while the 1 bit might be something "near" 3 or 5 volts. As long as the 0 voltage doesn't get too big, or the 1 doesn't get too small, circuitry can still reliably tell the difference between them. If you tried to represent decimal digits with voltages, it might be too difficult to tell the difference between one digit and another if the voltage changed a bit as it travels from one place to another.

DETOUR

There was a very fast swing to the use of digital circuitry back in the 1960s and '70s, when digital integrated circuits (ICs) became cheap enough for common use. The most common digital ICs were called Transistor-Transistor Logic, or TTL.

TTL ICs work on two different voltage levels. Anything between 0 and 0.8 volts is one voltage level, while the other is anything between 2.0 and 5.0 volts. Many users call the near-zero voltage level a 0, and the 3–5-volt level a 1. But this is a bad practice, because many designers use the near-zero voltage to stand for a 1, and the 3–5-volt level be a digital 0 signal, which happens to be the exact opposite. (And many designers even switch back and forth between the two systems, sometimes just a few tenths of an inch apart in a circuit.)

To stay out of trouble, don't use the terms "zero" and "one" to refer to digital signals. Instead, call the 0 to 0.8-volt level a *low*, and call the 3–5-volt level a *high.* This is always safer.

TTL voltage levels are still common today; even though many ICs are no longer TTL, they still usually use the same voltage levels.

Incidentally, the words high and low can be used with other voltages as well. For instance, a high might be +15 volts, while a low might be -10. The only thing required is that the high voltage really be higher than the low.

END OF DETOUR

Although the numbers in Table 3-1 are all different lengths, note that the value of a number doesn't change if you put extra zeroes in front of it. In decimal, for example, 7, 007, and even 00000007 all have the same value. In computers, binary numbers are often stored in groups of eight bits, called a *byte*. Thus the binary equivalent of a 7 would usually appear as 00000111, rather than just 111.

Looking at Table 3-1 again, we note that, if you were limited to one-bit-long numbers, you could only express two different ones: 0 and 1. If you used two-bit-long numbers, then you could express four different numbers: 00, 01, 10, and 11, which correspond to the decimal numbers 0, 1, 2, and 3. Likewise, a three-bit number can have eight different values, which correspond to the decimal numbers 0 through 7. We can generalize this rule as follows: a number with n bits can have 2^n different values, corresponding to the decimal numbers from 0 through $2^n - 1$. For example, an eight-bit byte can have 28 or 256 different values, which correspond to the decimal numbers from 0 through 255.

A typical byte in a computer could represent one of three things:

A number, or part of a number, used in some computation,

An instruction, or part of an instruction, telling a computer what to do, or

A letter, number, or punctuation mark, coded in ASCII (which stands for the American Standard Code for Information Interchange) These are often called *alphanumeric characters*, or just *characters*.

Serial and Parallel Data Transfer

When binary data is moved from place to place, it is most often moved in bytes. A byte can be transferred from place to place in one of two ways:

Parallel transfer: all eight bits of a byte move at the same time along eight separate wires.

Serial transfer: the eight bits travel on one wire, but in sequence ("serially"), one after another.

Actually, parallel data transfer requires more than eight wires. For example, the most common parallel connection is from a PC computer to a printer; this connection usually involves a 25-pin connector and cable:

8 wires carry the eight bits of data

1 wire carries the data-ready strobe, a signal that tells the printer that a byte is ready

1 wire carries a data-received signal from the printer back to the computer

1 wire carries an out-of-paper signal from the printer back to the computer

1 wire carries a busy signal telling the computer that the printer is busy

1 wire carries a ready signal, telling the computer that the printer is on-line and ready to receive data.

12 wires connect the grounds of the computer and printer together.

The data-ready, data-received, out-of-paper, busy, and ready signals are often called *handshaking* signals because they allow the computer and printer to agree on when and how fast to send data. The reason for twelve ground wires is that the printer connection is often done with a ribbon cable; in order to prevent interaction between closely-spaced adjacent wires, the 13 signal wires are separated by 12 ground wires.

A parallel connection can be quite fast since (1) all bits travel simultaneously, and (2) the handshaking signals allow the computer and printer to communicate at their maximum speed, yet still slow down if one falls behind. On the other hand, the parallel connection requires a lot more wires (even if you cut it down to the bare minimum number of wires needed.) Hence parallel connections are only used for short distances.

All long-distance data transfer is therefore done through serial connections. In these, all data bits as well as some simplified handshaking signals travel along one wire (although there is also at least one additional ground or return wire.)

RS-232 and Asynchronous Serial

The most common serial connection is known as RS-232. Although it also often uses either a 25-pin or 9-pin connector, only two wires are absolutely necessary in an RS-232 connection: one for signal, the other for ground.

For example, the ASCII code for the lower case letter *a* in a personal computer is 01100001. If you looked at the letter *a* carried on an RS-232 signal wire, with an oscilloscope, you would see the waveform in Fig. 3-1.

First, you note that although the code is 01100001, the bits shown in the figure are 10000110, which is backward. That is because they really *are* sent backward. The rightmost 1 (at the end of 01100001) is called the *least significant digit* or *lsd*, and is sent first; the leftmost, called the *most significant digit* or *msd*, is sent last. There is a historical reason for this, which we'll see in a moment.

Next, you will note that a 1 is a negative voltage, labeled as -V in Fig. 3-1, while the 0 is a positive voltage labeled +V. The precise voltages are not specified, and could be anything from 3 volts up to 15 volts. Hence, in one system the voltages might be -5 and +5 volts, while in another they might be -12 and +10, or whatever.

There is room for some confusion here, since many people wrongly think that a 1 has to be more positive than a 0, which of course is not the case here. To avoid that problem, many communications people therefore call the 1 signal a *mark*, while the 0 signal is called a *space*. (To use our earlier terminology, a the mark or 1 signal is the low here, while the space or 0 signal is high.)

At the top of Fig. 3-1 is the notation "1 bit time" which shows the length of one bit. Within the byte, each bit has exactly the same length, which we call a *bit time*. The string of four zeroes in the middle, for example, is exactly four bit times long. Both the sender and the receiver must agree on the exact length of a bit so that, when a string of ones or zeroes arrives, the receiver can determine exactly how many bits there are in that string.

Once we know the length of one bit, we can calculate the maximum number of bits per second. For example, if each bit is 1/300 second, there could be a maximum 300 such bits sent per second. Thus the *bit-per-second* or *bps* rate is defined as

bits-per-second = 1/(1 bit time)

Since both the sender and receiver have to agree on the bit-time (and therefore the bps rate), there are certain bps rates which have become

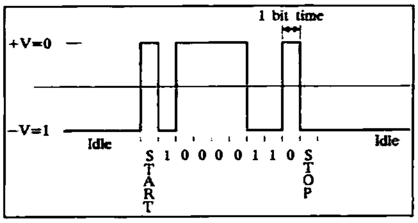

Fig. 3-1. A serial RS-232 letter "a"

standardized over the years. These are 300, 600, 1200, 2400, 4800, 9600, etc. You can see the pattern in these. Incidentally, you often see the bps or bit-per-second rate referred to as the *baud rate*. This is not entirely right, since baud rate has a different meaning from bps; still, it's a common use, and we might as well live with it. (When we get to discuss modems, we will see what the difference is.)

Although the timing of the bits within a character is very exact, the timing between characters is not. For instance, if the signal is coming from a keyboard, there might be long spaces between characters as the typist is searching for the next key. For that reason, this kind of serial data transmission is called *asynchronous*, meaning not synchronized. The bits are carefully timed (synchronized to a clock), but the characters are not.

Thus there has to be a way of telling the receiver when there is nothing being sent, and when the next character begins. The "nothing is being sent" condition is called an *idle*, shown as a 1 or mark signal in Fig. 3-1. Note that there can also be a 1 or mark signal inside a character, but that will generally be shorter.

The "character is starting" code is called a *start pulse*, and is always a 0, or space, which follows the idle. Thus a long mark (1) followed by a space (0) pulse marks the beginning of a character.

Since the sender and receiver will always agree beforehand on the number of bits in the character (usually eight), they can count bits from the start pulse and figure out when the character is over. Hence they don't really need a stop signal. Nevertheless, there is always a *stop pulse* sent at the end, which is always a 1. This is another of those historical things, dating back to when mechanical distributors (much like the distributor in a car) were used to convert to and from serial data in teletype machines. These distributors were run by a motor, and a clutch needed time to start and stop the distributor for every character. In fact, these systems often needed extra time, and so the stop pulse was extra long. We still sometimes hear of "two stop pulses," which really just means a stop pulse of double the normal length.

When serial data is sent slowly, such as from a keyboard, the stop pulse is usually followed by another idle signal of some unknown length. But when the data comes from a computer, it can come at maximum speed. In that case, the stop pulse might be immediately followed by another start pulse, with no idle between them. If you start watching such a data stream in the middle, things can get somewhat confusing since you can't tell which zeroes are start pulses, and which zeroes are data bits. To be really sure, you have to go back to the last previous idle time, and start counting bits from there. Computers also often get confused—if you temporarily break the connection in a serial line you mess up the timing, and all the following data may be wrong until things slow down and the next idle reestablishes synchronization.

In any case, we now see that an eight-bit byte sent on a serial line actually takes a total of ten bits. The addition of the two start and stop bits adds a 25% *overhead* which slows down the transmission. (Hence computer-to-computer data transmission often uses *synchronous* transfer, which doesn't waste as many bits.)

Parity

Let's return to ASCII for a moment. As mentioned earlier, ASCII is a code for encoding letters, numbers, and punctuation marks into binary bits. Although we earlier said that the code for the letter *a* is 01100001, that's not quite true. The true ASCII code is just seven bits, and so it's really just the seven bits 1100001. So where does that eighth bit come from?

Since computer memory locations (at least, those of smaller computers) come in eight-bit bytes, there is an extra bit left over when storing a seven-bit ASCII character in such a memory location. This extra bit can be treated in several ways.

It can be left unused. But since you can't just leave the bit empty, you must put something into it. Hence you could routinely just force it to be a 0 or a 1. In this case, the letter *a* could be stored as 01100001 in some computers, and 11100001 in others.

It can be used to increase the number of available characters. For instance, in PC-clone computers, this extra bit is a 0 for all normal characters, but becomes a 1 for special characters. For example, 01100001 in such a computer is still an *a*, but 11100001 is used to store the Greek letter ß This allows the computer to use an extended character set which includes symbols like ±, π, √, ≥ and °, which are not in the regular ASCII code. This code is sometimes called *extended ASCII*.

It can be used for *parity* error checking. This is not usually done in small computers, where errors tend to be rare, because signals travel shorter distances or because other methods are used to check and correct errors. But parity checking is common when data travels a long distance.

Parity comes in two types—*even parity* and *odd parity*. In even parity, the eighth bit is chosen so that the total number of ones in the character is even; in odd parity it is made odd. For instance, the ASCII code for *a* is 1100001, which has an odd number of ones. For even parity, an extra 1 would be added so that the total number of ones in 11100001 is even; in odd parity the extra bit would be 0 to keep the odd number of ones in 01100001. Another example is the capital letter A, whose ASCII code is 1000001. This would become 01000001 in even parity, and 11000001 in odd parity.

If you've ever seen abbreviations like 8N1 or 7E1, now you can understand what this means:

8N1 means eight data bits with No parity bit, and one stop pulse.

7E1 means seven data bits plus an Even parity bit, and one stop pulse.

Note that the circuitry can't generate or check a parity bit until it has the remaining seven bits of the character. This is the reason why each byte in an RS-232 serial line is sent backward—to put the parity bit at the end, after all the previous data bits.

Error correction and error detection

The idea behind using parity is that every character sent has a specific 0 or 1 bit in that eighth or parity position, determined by the rest of the bits. If any one of the bits in that group somehow gets changed due to an error in transmission, the number of ones will add up to the wrong number, and the receiver can detect that an error has occurred. But note that if two bits (or any even number of bits) get changed, the error can't be detected. For instance, if the 01100001 for an odd-parity *a* gets changed to 01100111, the number of ones is still odd, but the *a* was changed to a *g*

without the receiver being able to detect a parity change. The reason is that with just one parity bit, the chance of an error occurring but the parity still accidentally being right are 50%.

Detecting, and even possibly correcting, errors in digital data is important, because an error in just one bit can make a huge error. Hence the parity bit is a useful step, but not enough.

There are a number of ways of handling errors. The most important step is to be able to detect them, because once you know an error has occurred, you can take steps to fix it. One way is to increase the number of parity bits to reduce the chances of an error going by unnoticed; in this case these bits are usually just called error-detection bits, rather than parity bits.

One common way to do this is to generate a CRC or *Cyclic Redundancy Check* number with a CRC generator. The CRC generator is basically a number of computer building blocks called *flip-flops* (usually 16, although more or fewer can be used), which are interconnected using additional computer components called *gates*.

The flip-flops are computer circuits which can store either a 0 or a 1 bit. Initially, all the flip-flops are set to hold a 0, and then the outgoing string of bits in the sender is passed through the chain of flip-flops. After all the bits pass through, some of the flip-flops wind up holding a 0, while others hold a 1. The precise bit pattern in the flip-flops depends on what data went through and how they are interconnected. If there are 16 flip-flops, then they wind up holding a 16-bit number called the CRC, which is then sent after the data as an extra set of bits.

In the receiver, an identical CRC generator circuit receives the data, and also generates its own CRC. If there was no error, the CRC sent by the sender should therefore be identical to the CRC generated in the receiver. If they are different, then an error occurred somewhere along the way.

When 16 flip-flops are used to generate a 16-bit CRC, the CRC number itself could have any one of 2^{16}, or 65,536 different values. When an error occurs, there is only 1 chance out of 65,536 that the resulting CRC will accidentally be the same as the correct CRC that was generated by the sender. This means that only 1 out of 65,536 errors is likely to sneak through without being caught; in other words, 65,535 times out of 65,536 the error will be detected, which means that the data has a 99.998% chance of being correct. That's a lot better than the 50% chance with just a single parity bit!

Even with just an 8-bit CRC which has 256 possible values, there is a 255 out of 256 probability, or 99.6% of an error being detected.

When an error is detected, how do you correct it? There are two ways: *backward error correction*, and *forward error correction*.

In backward error correction, when the receiver detects an error it asks the sender to transmit the data again. Forward error correction involves sending enough extra (called *redundant*) bits right away so that the receiver can correct an error without asking for a retransmission.

Backward error correction is fairly straightforward. It's what we use every day when we say to someone, "Huh? What was that? Say it again?" The only catch with it is that we need what is called a *reverse signal path*; that is, we need some way of getting a message from the receiver back to the sender. In many communications methods there is a two-way path, so it's easy to get that message back to the sender; sometimes, though, that reverse path may not be present. For example, if a sender (such as a pager transmitter) sends a signal to many different receivers (such as pagers), it's not practical for each receiver to be able to reply to the sender.

Even in simple cases, sending a reverse message asking for a correction takes extra time. Thus backward error correction is more useful if there are relatively few errors so you don't have to ask for too many repeats.

Forward error correction is more interesting, and more difficult. It uses a class of *error correcting codes* or ECC which have built-in redundancy.

Redundancy means including more information than really necessary. For example, the English language has a lot of redundancy, because you can often remove a lot of letters from a message without losing essential information. Consider the sentence "Ths sentins has a lutt of errurs." Even though there are missing letters, extra letters, and even some wrong letters, you know what it says. That's because of redundancy.

The same can be built into computer messages. As a really simple example (since most ECC codes can be quite complex), consider what is called *longitudinal parity*. Let's say you send the word Help in ASCII with even parity:

H = 01001000
e = 01100101
l = 01101100
p = 1111000

so the message reads

01001000
01100101
01101100
11110000

If one single bit somewhere in the four bytes gets changed, you can detect the error and you know which *letter* is wrong, but you cannot correct it because you don't know which *bit* of the eight in that letter is wrong. But suppose you add an additional set of even parity bits, called longitudinal parity, going down the list, like this:

01001000
01100101
01101100
11110000
10110101

The fifth group of bits has been chosen so that *the number of ones reading down any column is also even*. Now suppose an error occurs so *one* of the bits somewhere gets changed, such as the fourth bit in the third row, which got changed from a 0 to a 1:

01001000
01100101
01111100
11110000
10110101

As a result, the third row now has the wrong parity because it has an odd number of ones; the fourth column now also has the wrong parity. We therefore know that the error is in the third row and fourth column, and so we can change the bit in that position from a 1 back to a 0.

This kind of error checking can detect and correct a single bit error, and can detect (but not always fix) a two-bit error. That isn't good enough for most communications applications, because quite often noise bursts and other problems cause an entire series of bits to be wiped out. Hence more sophisticated error correction methods are used, but other than knowing about them, we need not really study them further at this point.

Synchronous Serial Data Transfer

The asynchronous serial method we've discussed so far has the advantage of being simple, but it also has a number of disadvantages. The primary one is that it is inefficient—not only are there two overhead bits for every eight data bits (which wastes time), but the parity bit (if used) adds still another wasted bit that doesn't really do a good enough job of detecting errors. Synchronous data transmission is a way around that. But because it is more complicated, it is generally only used in high-speed applications, such as when two computers are communicating directly with each other. You will seldom see it in a home or small office PC.

In the synchronous method, many bytes of data (usually some power of 2, such as 128 or 256) are sent, one right after another, without separating them by stop and start bits. But now timing becomes very important because a very large number of bits is sent in arow, and even a slight error in timing them could cause a miscount. Error detection is also important, because in a long string of bits there is a greater probability of something going wrong. Synchronous data transmission therefore usually works something like this:

When there is nothing to send, the sender sends an idle signal. What this is depends on whether there is only one sender on the line, or whether the same line might be used by several senders. If there might be multiple senders, then the idle is nothing—not mark or space, but literally nothing—an open connection. If there is only one sender, then the idle is more likely to be a continuous string of bits rather than a continuous mark or 1 signal. For example, the system might send a continuous string of 01010101...bits.

To signal the start of data, the sender sends a different series of easily recognizable bits, instead of a start pulse as in asynchronous data. For example, the sequence 00111100 or 10010110 might be used; both of these are sufficiently different from the idle to be easily recognized as something new.

Next comes the data, generally as a fixed-length group of bytes. Typically there might be 128 or 256 bytes, though it might be some other power of 2.

After the data would come a CRC, usually a 16-bit number, which provides a fairly good probability of detecting errors. The CRC might be followed by another short idle signal, or there might be another start sequence.

Back to bandwidth

In previous parts, we discussed the bandwidth needed for audio and video signals. What about the bandwidth for digital data?

Although digital signals don't exactly consist of square waves, they look close enough to square waves that we suspect that there are a lot of harmonics. Although we haven't specifically said so before, a general rule of thumb is that the faster signals change—the more kinks and corners they have—the higher the frequencies in that signal. This almost certainly means that there will be a lot of harmonics, and so it implies that we need lots of bandwidth.

That is generally true; fortunately it's not as bad as it seems. As we mentioned earlier, the reason that binary numbers are used instead of decimal numbers is that it is easier to tell the difference between a 0 bit and a 1 bit than to have to tell the difference between ten different digits. Even if a digital signal gets all distorted, it may still be possible to read it without errors as long as the ones and zeroes do not get totally confused with each other.

For example, Fig. 3-2 shows a "before" and "after" comparison of a digital signal that went through a communications circuit whose bandwidth was too low, so that many of the harmonics were reduced or eliminated. This much distortion on an audio or video signal might be disastrous; yet the digital signal can be recovered from the "after" signal with fairly simple circuitry. The timing will be slightly changed, but even that can be fixed. As a result, the digital data would go through this system without major errors.

Let's keep in mind that there is no such thing as a perfect communications circuit. There is never enough bandwidth, always a bit too much distortion, always a bit too much noise. These will always affect an audio or video signal in some way; in fact, they will affect all analog signals, and once some noise or distortion affects an analog signal, it is almost impossible to clean it up again.

Digital signals, however, behave differently. As long as the 0 and 1 bits are recognizable, they can usually be recovered and the original digital data will come through without change. And once recovered, that same data can be sent once again through another circuit. Thus, as long as you *regenerate* the data often enough, you can send it as far as you'd like without its being corrupted. This is one big advantage of digital data transmission over analog data.

Claude Shannon, a Bell Laboratories mathematician, calculated back in 1948 the absolute maximum theoretical number of bits that can be sent through a communications circuit in one second as

max bps = $BW \log_2 (S/N + 1)$ where BW is the bandwidth, and S/N is the signal-to-noise ratio—the ratio between the signal power and the noise power.

Mathematicians call the expression $\log_2$ in this equation the "logarithm base 2." Calculating it is somewhat difficult, so for a good approximation let's think of it simply as the number of bits needed to represent the value of (S/N + 1). For example, let's consider a telephone line with a bandwidth of 3000 Hz, and suppose the power of a telephone signal is 30 times higher than the power of the noise, so $S/N = 30$. We need 5 bits to represent the number 31 (which is 30 + 1), so the theoretical maximum number of bits per second in a telephone connection would be 3000 times 5, or 15,000 bps. (With modern telephone lines, and with some tricks to compress data, it is possible to go somewhat higher.)

Depending on the quality of the connection, sometimes the data may have to be sent too slowly to be of use, and sometimes error correction may be needed. But digital data can be sent almost unlimited distances almost without errors—as long as it goes slow enough.

For this reason, sending audio and video analog signals digitally is a useful technique. We will return to this concept later; for now we need just say that the idea is to take the audio or video signal, digitize it with an *analog-to-digital converter*, send the digital information,

Continued on page 82

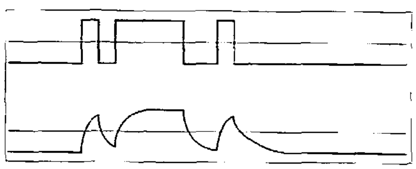

Fig. 3-2. A digital signal, before and after distortion

A Simple Capacity Meter

Have fun building your own with this simple construction project.

J. Frank Brumbaugh KB4ZGC
Box 30
Salinas PR 00751-0030

Grab bags of capacitors, as well as similar assortments of small components including capacitors, are often offered at low prices by mail-order surplus parts dealers. Similar opportunities for stocking up cheaply on small parts present themselves at every hamfest flea market. The methods used for marking capacitance values, usually consisting of a code indicating the value in picofarads or nanofarads, etc. Sometimes they are marked only with a manufacturer's "house" number. The codes are all different and are often confusing. We need something to bring order out of chaos and allow easy determination of capacity values.

"This simple capacity meter uses the fewest, least expensive, component parts, most or all of which can be found in any ham's junk box."

There are, of course, very expensive LCR meters available commercially, at prices well over $100, which measure capacity as well as inductance and resistance. Full-function digital multimeters (DMMs) with prices starting around $75 usually provide a means for measuring capacitance, but instruments such as these are usually beyond the average ham's budget. What is needed is an inexpensive, simple to construct and use, instrument to measure capacity over the most important range used in ham equipment.

The instrument described here uses the fewest, least expensive, component parts, most or all of which can be found in any ham's junk box. It measures capacity over the range of approximately 25 pF to 0.002 µF, the range which encompasses those capacity values which usually must be known. In only a few circuits—AF and RF filters, for example—is it necessary to select specific, usually nonstandard, capacity values. Often a trimmer capacitor is added, such as in VFO circuits, to adjust capacity to a specific value. But all components in a circuit have tolerances of 5, 10, 20 percent or more, and because electronics is a world of varying tolerances it is not necessary to know the value of a capacitor to the last picofarad. You only need to discover where in the table of standard values an unknown capacitor belongs, considering its manufacturing tolerance, which is often unknown.

For example, an 820 pF ±5% capacitor can have a capacitance between 779 pF and 861 pF and still be considered an 820 pF capacitor. If the tolerance is ±10%, which is more common, its actual value could be anywhere between 738 pF and 902 pF. But it is still an 820 pF capacitor and is so marked.

Stray (unwanted) capacitance is added to every circuit whenever a wire or component is added. You can't avoid it; usually it's not important except in a few circuits, particularly at VHF and above.

As an example, this instrument is *theoretically* capable of measuring to as low as 1 pF, but in the real world stray capacity prevents measurement much below 25 pF. It could be easily modified to measure much larger capacitances, but since capacitors of 0.001 µF and larger are usually used in bypassing and decoupling where tolerances of the circuit are so great, whether you use a 0.01 µF or 0.1 µF capacitor, the circuit will function correctly.

The Circuit

Fig. 1 shows the schematic diagram of the Simple Capacity Meter. U1 (a 74LS00 logic chip), two resistors, a capacitor and a crystal form a crystal oscillator operating near the marked frequency of the crystal.

The RF voltage is taken from pin 8 through isolation capacitor C3 and applied to the modified Wheatstone bridge circuit. R3 forms two arms of the bridge, with the arms ratio variable through the position of the wiper of R3. C5, which should be the stable capacitor specified in the Parts List, and the unknown capacitor to be measured form the remaining bridge arms. R3 is adjusted for bridge balance, indicated by a dip–minimum shown on microammeter M1, and the value of the unknown capacitor is indicated on the calibrated dial attached to R3.

The instrument is powered by BT1, a 9-volt battery, controlled by ON-OFF switch S1. This 9 volts is reduced and regulated by U2, a 78L05, to the +5 volts required by U1.

Construction

The circuit should be constructed on a piece of perfboard, or on one of the small general-purpose printed circuit boards available at Radio Shack. It should be mounted in a plastic enclosure rather than an aluminum case, or one made from printed circuit material. This will greatly reduce the unwanted stray capacity.

Leads from the top of R3 through C5 to Jl must be as short and direct as possible. Leads connecting to Jl and J2 should be of solid wire, run as directly as possible. Leads of D1, especially the anode lead, should be very short. Hold the diode leads close to the diode body with needlenose pliers or an alligator clip to serve as a heat sink to protect the diode when soldering its leads. The leads of C6 should also be as short as possible.

Meter Ml can be any of the inexpensive plastic edgewise or square surplus tuning meters originally made for CB or home entertainment equipment. They are available at hamfests and also from several mail-order surplus parts dealers for $2 or $3 each. Movements are d'Arsonval and usually between 200 and 300 microamperes. However, if you own an analog VOM with a current range scale of 100 to 300 microamperes, you could install another pair of binding posts instead of Ml, and use the VOM on the proper scale in its place, saving the cost of a meter.

You will have to make a dial for R3. Most hams save the circular metal cutouts resulting from holes for meters and speakers. These make ideal dials when white card stock is glued to one side, trimmed, and the blank dial centered and cemented or epoxied to the bottom of the knob for R3.

If you do not have such a circular cutout you can scribe a circle on a sheet of heavy, stiff plastic or cardboard, cut it out carefully with scissors or a hobby knife, then cut a hole in the exact center the diameter of the shaft of R3. If your dial does not have a clean white surface, glue a piece of white paper or index card on it. Trim it when the adhesive has dried, and cement or epoxy it to the bottom of the knob for R3.

Mount the completed knob and dial on R3. Scribe or otherwise draw an index line on the enclosure extending a short distance from the edge of the dial.

"This capacity meter measures capacity over the range of approximately 25 pF to 0.002 µF, the range which encompasses those capacity values which usually must be known."

Calibration

You will need to borrow or purchase several fixed capacitors to use in calibrating the dial. The following values, all expressed in picofarads, are suggested: 33, 47, 68, 100, 150, 220, 330, 470, 680, 820, and 1,000. Because polystyrene and mylar capacitors are usually very close to the marked values, this variety will provide the most accuracy. Dip mica capacitors with a 5% tolerance is a second option. If you can't get all the suggested values, get what you can and use them. You can calibrate other values any time a suitable capacitor becomes available.

Switch Sl to ON. Connect a calibration capacitor between Jl and J2. Rotate R3 for a dip in the indication on the meter, either Ml or your VOM if used. Mark a short line on the dial in line with the index mark on the panel. Number it with the value of the calibration capacitor. Continue calibrating the dial as just explained, using the remaining capacitors.

The dial will be nonlinear, being crowded at the high capacity end where accuracy is less important, but expanded at the low capacity end where accuracy may be of greater importance.

Operation

Switch S1 to ON. Adjust R3 so its wiper is away from ground. An indication on the meter shows operation to be normal. Connect an unknown capacitor between Jl and J2. Adjust R3 for a dip on the meter. Read the capacity on the dial opposite the index mark.

Because of normal tolerances,, few capacitors will measure exactly at the calibrated values. If the indication is quite close, that is the nominal value of the unknown capacitor. Extrapolate between calibrated values as necessary to identify the capacitance of capacitors lower or higher in the table of standard values. If you cannot get a dip within the range of R3, first check to see that the capacitor leads are firmly connected to Jl and J2. If you still cannot get a dip, the capacitor is probably larger or smaller than can be measured with this instrument. It also may be defective (usually open or shorted).

Switch Sl to OFF when measurements are completed, to save the battery from an untimely demise.

Comments

In the vast majority of circuits, if, for instance, a 47 pF capacitor is specified but you don't have one, you can probably substitute any value between about 33 pF and 68 pF without any adverse effects. Murphy's Law will always prevent you from finding all the parts values called for on the schematic diagram, regardless of how extensive your stock of parts may be. So don't hesitate to substitute, within reason.

When a mica capacitor is called for you can usually substitute a mylar or polystyrene capacitor, and vice versa. If an NPO or COG capacitor is specified, these two types are interchangeable, but do not substitute a different type. Some ceramic disc capacitors are NPO and will look as if the edge opposite the leads has been slightly dipped in black paint. Other than NPO, ceramic disc capacitors are not temperature-stable and their values shift as temperature varies. If an ordinary ceramic disc capacitor is specified, you can substitute any other kind of capacitor for the disc without any problem.

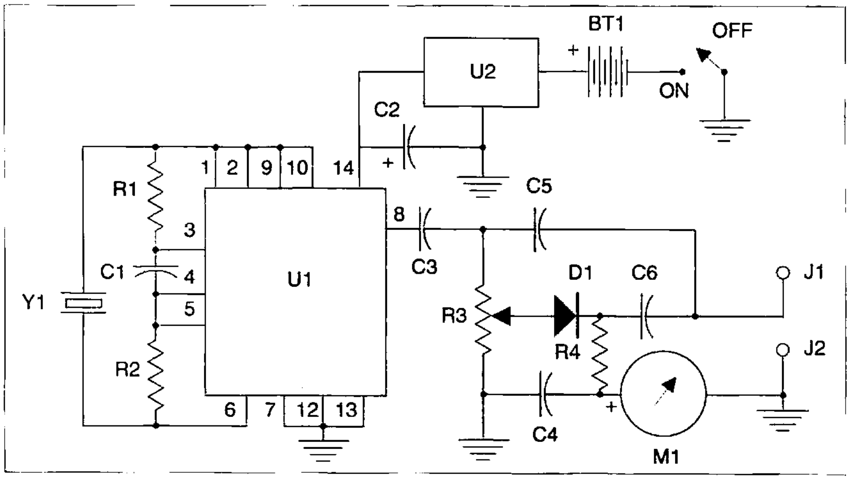

Fig. 1. Schematic diagram for the simple capacity meter.

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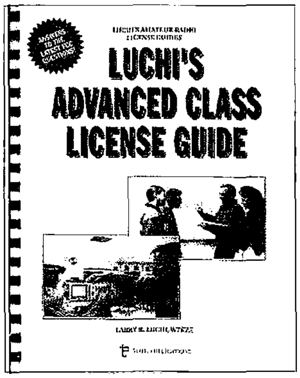


This 185p Luchi (W7KZE) 1995 guide covers the latest FCC question pool, with the questions you'll be facing, the answers, and the explanations. Call it a speed course in radio technology. No fair just memorizing this stuff since you're going to need a real understanding of it to go on to your Extra ticket. And it isn't all that difficult. After all, we have some seven-year old girls with Extras. You're not going to let a 7-yr old kid fake you out, are you? Spend the $23 (+ s/h). Tiare Publications, Box 493, Lake Geneva WI 53147. Get your Advanced ticket and come up and play with the big boys.

New Version of Computer-to-Scanner Interface Software

DataFile Inc. has released a new version of its computer-to-scanner interface software, Probe Version 2.0. The program will allow scanning enthusiasts to lock into active sets of frequencies, and return to normal scanning when traffic diminishes.

Probe was developed exclusively for Optoelectronic's OptoScan 456 and 535 Computer-to-Scanner interfaces, which work with Radio Shack's Pro-2005, 2006, 2035, and 2042 scanners. Over 70 new features and enhancements have been added to Probe.

SmartScan™ allows the operator to select a set of key frequencies. When a key frequency becomes active, SmartScan calls up a database of frequencies related to it and begins scanning them. When activity settles down, SmartScan returns to normal scanning.

Using SmartScan, the operator could select an air emergency frequency as a key frequency. When that frequency becomes active, Probe would begin scanning the local air tower, ground control, fire squad and airport security channels, for example.

The program will run on virtually any DOS-based computer, and is capable of scanning up to 50 channels per second on AT/12MHZ machines without additional memory, graphics cards, or operating systems.

The frequency database engine uses the dBASE format, allowing management of up to 4,000 groups of 99 banks. Each bank may contain up to 1,000 frequencies.

Rubber Duckie Antennas

MFJ has released three new flexible antennas for multi-band and 2M HT users. The MFJ-1717 is 15.75 inches in length, covering 440 MHz (where it is a half-wavelength) and 2M, where it operates as a quarter-wave.

The MFJ1716 is a quarter-wave on 440MHz, and a loaded quarterwave on 2M. It measures 8.75 inches. The MFJ-1718 is a helically wound high-Q antenna for 2M only. All antennas feature a high strength, high flex design with a new rubber coating. Contact MFJ Enterprises, P.O. Box 494, Mississippi State, MS 39762. Tel 800-647-1800.

VISAR Replacement Battery and Eliminator

Battery on that HT going dead in the middle of your first QSO after a night on the charger? W & W Associates has announced the addition of the VISAR replacement battery and eliminator to their extensive line of Two-Way batteries. The batteries are available in 7.5v @ 2000mAh and 7.5v @ 1200mAh.

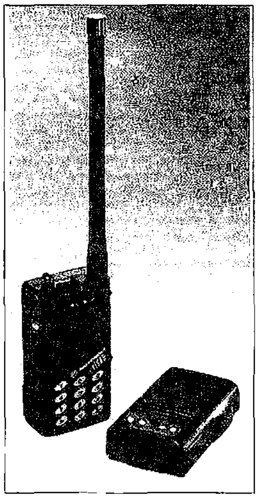
W & W also now stocks batteries for the Yaesu FT-10R/40R, The Icom series IC-W31, IC-21A, IC-T22A, IC-T42A and Alinco DJ190/DJ-G5

W & W can be reached at 516-942-0011 and is located at 800 South Broadway Hicksville, NY 11801-5017.

New HS-1000 All-Band HF Mobile Antenna.

Mobile HF operators have a new choice of antennas. High Sierra Antennas has introduced its new HS-1000 all-band HF mobile antenna.

The design incorporates features such as new low-cost mounting options, center-loading coil for high-power and high-temperature applications, a decoupler system, and improved matching system and a remote control panel with limit indicator.



The antenna provides coverage from 3.5 MHz to 30 MHz and beyond without sacrificing performance on any frequency. The variable loading coil is remotely controlled, so the operator can tune the entire HF spectrum without leaving the driver's seat.

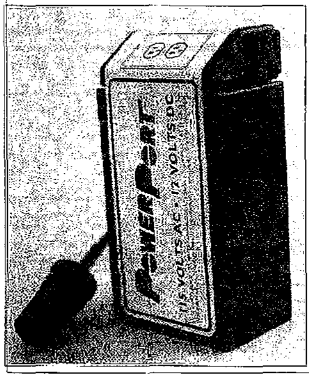
The HS-1000 uses two basic mounting systems. The Easy-off mount allows the entire antenna to be removed in about 30 seconds for safety or security. This method uses a tapered stud at the based of the antenna together with an upper clamping mechanism.

The new single point mounting method allows the antenna to be attached to horizontal surfaces.

The antenna can be purchased as a complete package, or in its component pieces for those who already own some of the hardware.

Portable AC and DC Rechargeable Power Source

Cutting Edge Enterprises has released, a portable AC and DC rechargeable power source.



Unlike currently available 12V power supplies, Cutting Edge's Powerport has an on-board inverter to make both 115V AC and 12V DC power equally available. This compact unit is built around a sturdy 12V 7 amp hour gel cell battery. It can b recharged with the supplied wall charger or, unlike all other models, can be charged in your vehicle without requiring the engine to be running. Price: $89.50 + $6.50 shipping. For more information contact: Roger Hall, Cutting Edge Enterprise, 1695 River Street, Santa Cruz CA 95060. Phone (800) 206-0115; FAX (408) 426-0115.

NEVER SAY DIE

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So what happened at the next conference ten years later, when the chickens came home to roost? That's another fascinating story. Remind me to write about that. I kept in close touch with the ITU hams for many years, so I knew what was going on from the inside. Also, remind me to write about how I engineered Budlong's forced retirement.

Sue Your Parents

If I weren't an orphan, I'd sure haul my parents into court and sue them for child neglect. This has to do with my reading an excellent instruction book on prenatal care. You're probably too busy in the hamshack to do what it takes to have any kids, but if you do ever decide to take a few minutes off from DXing to have a junior op, get this book and read it or I'll put you high on my list of hams to haunt with high line noise and defective transistors after I win my Silent Key award from the League (which I'm sure they have ready, just awaiting the date).

The book is *Prenatal Classroom, a parents guide for teaching your baby in the womb*. It's by Van de Carr and Lehrer, ISBN 0-89334-152-5, 161p, $13, published by Humanics Learning, Box 7400, Atlanta GA 30309. It doesn't say much that I didn't know before, but it is an excellent instruction book on how to communicate with your unborn child. How to teach it around 50 words, to like music, and stimulate brain growth before birth.

Back in 1950, when I got interested in Dianetics and studied at the Hubbard Dianetic Research Foundation, I found out how much that happens during the prenatal months affects us later on. It is really simple, under hypnosis, to regress anyone to the prenatal period and find the causes of many current-life psychological problems. It's also easy to erase these devilish influences, once you learn the tricks. As far as I know, this stuff hasn't been taught since the late Ron Hubbard, who I knew quite well, started Scientology and using the technology more for brainwashing than helping people. Well, he made hundreds of millions.

Instead of loading up your child with bad baggage, you can give it one heck of a head start by following the instructions in this book. The AMA says this results in significantly higher IQs, which means that if you don't use these techniques, you are permanently robbing your child of mental ability that is inherent. It's bad enough with our schools dedicated to dumbing our kids down without parents adding to the mess.

You can teach your unborn child to communicate with you, to recognize words, and even to like certain foods. One mother, who ate a lot of doughnuts during her pregnancy, had a child whose favorite food was doughnuts. Still is. They call her blimpy. One thing I know for sure, my mother didn't eat much eggplant.

And yes, if you let the poor kid hear a lot of CW, it'll probably grow up to be an ARRL director. I think that's probably what happened to poor old Harry Daniels W2HD, the ex-president of the League and internationally noted Wayne Green fan.

If you're into the grandfather class, be sure your kids get copies of this book to help guide them with your grandchildren.

The one aspect of the book that disappointed me was the lack of any attention to the pre-conception things you can do to give your kids the best chance at not screwing up their lives the way you have. My folks smoked and drank, and look at me, and sigh for what I might have been without the pre-conception destruction of many good traits and zillions of potential brain cells.

It shouldn't be any surprise that what happens during the nine months of pregnancy, when the child is growing from a pin-point fertilized ova into a baby, is going to be a big part of the programming of this new computer. Sure, the genes are like the ROM programming, giving us instincts, but from then on it's RAM memory and little Ickie can hear and record everything going on after just a few weeks. And, after twelve weeks, start tasting. Ickie feels pain, is sensitive to drugs in the mother's blood, and can be seriously traumatized by ultra-sound or the missionary position.

Since Dianetics is a lost art, as far as I know, your best bet is to create as little bad programming as you can and not count on being able to erase it later. I hope that makes sense. Anyway, I think you'll enjoy the book.

Tapping ET's Phone

Cosmologists are having bitter arguments over the age of the universe, complete with wild credential waving to back up unfounded theories. But, whether it's five, ten, or fifteen billion years, or even ageless, the odds seems heavy that (a) there is other intelligent life, and (b) that it is probably millions to billions of years ahead of us in technology.

Radio has been around for about a hundred years. Two hundred years ago anyone predicting that people anywhere in the world would be able to see and talk with anyone else at will would have been locked up in an insane asylum. Well, that was before mental hospitals. Considering that technology developments have been speeding up, I suspect that any predictions we might make for 2096 would be as far off the mark as the 1896 predictions for 1996, where they thought we would be up to our armpits in horse manure in our cities. Instead, it's exhaust fumes.

As soon as a communications medium which is instantaneous and unlimited in bandwidth is discovered, radio will be quickly phased out, just as were smoke signals, then signal lights, and spark transmissions.

Meanwhile, science has, for the most part, turned a blind eye and deaf ear to the tens of thousands of reports from seemingly sincere and sane people who claim to have had contact with visiting ETs, and millions of people who have seen UFOs. Look, once we get far enough developed so we're able to visit planets in other solar systems, I doubt we're going to go in like Captain Kirk and offer to share our advanced technology with some species which hasn't even learned to fly. And how long have we been flying? Well, sure, the Wright Brothers got off the ground in 1908, but I was on the very first commercial flight between Philadelphia and New York, so practical aviation isn't very old.

My dad designed and built the Philadelphia Central Airport (in Camden), so I was right in the middle of the early days of commercial flight. All of the well-known aviators of that era used to come over to our house to visit.

It seems likely that any civilization advanced enough to travel to other solar systems will also have survived their natural warrior background and developed a more peaceful system for living with their advanced technology, so they'll probably visit more out of curiosity than a need to conquer more worlds. And this would mean a low profile, which seems to fit exactly what we're experiencing.

Quantum mechanics is giving us some hints on the possibility for instantaneous communications, and perhaps even space travel over any distance. But QM seems to be a link between matter and thought, so scientists are very uncomfortable with it. We're not sure what matter is yet, and we haven't much in the way of clues about thought. We're like people 200 years ago in this respect, and still ready to crucify any scientist daring to look deeply into these matters. Like the Harvard professor and his recent book on his interviews with contactees.

How about you? Are you a UFO believer? Or skeptic? Do you really believe that every single one of the expert observers who have reported in detail on UFOs has been mistaken or is lying? That every single report, with many based on observations by hundreds to thousands of people, are baloney? How about contactee stories? They are now into the thousands, with most of the people involved keeping quiet about it and wishing it had never happened. Are every one of these people deluded or liars?

Sure, as with any such field, there are a bunch of weirdoes and

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Number 76 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the May 1996 classified ad section is March 12, 1996.

NEVER SAY DIE

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nut cases. But then we have those in just about every field. You should see the stuff I get in the weird science and health fields! But the trouble is that in amongst the crazies and scam artists there are some serious and dedicated people who should be heard. Sorting the wheat from the chaff isn't easy.

I have a file drawer full of alternative health claims. The part that worries me is that I doubt that 100% of them are phony. So how are we going to find out what's worth while and what isn't? In the health field we know that the medical establishment, which includes our government, isn't going to even try. And we've seen what happens when the government gets involved with UFOs: cover-ups and obfuscation. They throw dedicated scientists into prison and destroy their laboratories, as they have with Wilhelm Reich, Royal Rife, and many others. And tried to do recently with Naessens.

If you are interested in getting involved with the SETI project and lending your radio ear to the multitudes scanning the heavens for errant ET signals, call 800-AU-SETI for instructions. This is a private group, so at least you won't be messing with the government, which I don't trust any further than my vote goes. Which isn't very far. I'm trying to remember if I've ever had a pleasant meeting with government people. Yep, I've had many very positive contacts with the FCC and, since Prose Walker got canned, few negatives. I can't say the same for the IRS, FDA, FBI and a few of the other government strong-arm outfits. But, even if the project fails to detect any ET signals, you'll have had an adventure trying if you get involved. And you'll learn a lot about weak signal reception and antennas.

Frankly, I doubt that SETI is going to accomplish much. We'd do a lot better to look for clues as to a new communications medium. It's really arrogant of our scientists to believe that they've now invented all there is to invent in communications systems. It reminds me of the attempts a little over a hundred years ago to build better telescopes so they could look for smoke signals or mirror reflections from other planets.

Psychic Pets

Have you got a dog? A cat? Some other kind of pet? There's a couple of books I somehow have to get you to read. Yes, I know, you only read technical magazines. Or novels. So how am I going to break you loose and get you to read some non-fiction? Sure, I've read some wonderful novels. I've got 22 shelves of 'em in my library. But few of them added much to my life in the way of understanding. Well, maybe Sinclair Lewis and John P. Marquand's novels were worth while long term.

Back in February I tried to get you to read *Kinship of All Life* by J. Allen Boone. But my recommendation just went in one eyeball and out the other. I know that for a fact because if you had read the book you'd have written, thanking me for allerting you to such an incredible treasure. It's not only an interesting story, it's true, and even worse, it is an instruction manual on how you can communicate with your pet. If you have a problem finding the book you can try Item #5280, Laura Lee Books, Box 3010, Bellevue WA 98009 - 800-243-1053. A reader let me know about that. Get their catalog...it lists several of my recommended books.

You see, animals, lacking speech, communicate on a more psychic level. And they communicate very well without being able to talk. I've had a lot of pets down through the years, so I sure wish I'd known more about how to communicate with them. Let's see, we had a blue and yellow macaw for about 30 years. And there was a rhesus monkey. A six-foot indigo who was very friendly. Greyhounds, Italian Greyhounds, Afghans, Burmese cats, a couple goats, a couple horses, a turkey, an African swan goose, and so on.

While I was down at the Virginia Beach hamfest to give a couple talks, I made my usual pilgrimage to the Edgar Cayce book shop. This time I only found one new book that looked interesting. It was *Psychic Pets* by Wylder, on sale for $6. It was a 1995 reprint of a 1978 book, ISBN 0-517-69265-1; 150p; hardbound. It's packed with stories of psychic performances by pets. Like the pet canary that tapped on the window of the next door neighbor one cold, rainy night. The neighbor opened the window to let it in, but it died at that moment. The neighbor recognized the canary and went next door to tell the owner and found she had fallen and was helpless.

Then there was Sugar, a Persian cat, who was terrified of being in automobiles. When his owner had to move from California to Oklahoma, he gave Sugar to neighbors who wanted him rather than try to force him to make the 1,500-mile car trip. Fourteen months later Sugar showed up at the Oklahoma farm and moved right in. He had an odd hip deformity, so they knew it had to be Sugar, and not a cat that looked like him. They called the family they'd left him with and they said yes. Sugar had left 13 months ago. He walked 1,500 miles and found his family in a place he'd never been before. Sugar had to average about four miles a day, plus somehow get food and water, for over a year!

The book is filled with stories of animals being clairvoyant and warning their owners in time to save their lives, of animals helping each other, and so on. If I run into you on 20m I'll tell you a few more of the amazing stories. Like how cats in London knew a half hour or more before radar was able to pick up incoming raids and headed for the bomb shelters, thus warning the people.

I'll bet you've got an animal ESP story I'd enjoy. The next time I'm in your area, if you have an open repeater that doesn't time out in one minute, I'd love to hear it.

League Bummer

Here goes Uncle Wayne, attacking the poor old League again. So who else has the stupidity to attack a religion in print? This time I thought you ought to know about a letter to *QST* that they're surely not going to publish. It's from Steven Morris K7LXC, griping about the April article, "Dialing For Deals." The article encouraged their readers to whipsaw ham dealers to get the lowest possible price...thereby eventually putting all but the few dealers with the lowest overhead out of business.

As Steve points out, the end result of us always shopping for the lowest possible price forces dealers to give less and less service to compete. Thus the article does a serious disservice to both ham dealers and amateurs. Of course, if you aren't ever going to want any service and are happy to buy everything by mail order from the manufacturer, then perhaps forcing most of the ham dealers out of business isn't a problem. Eventually all manufacturers will have to sell directly via mail order. And that would mean even more ads for *QST*, which could be exactly what the League has in mind in pursuing this tack.

Meanwhile, I'm sure that the few ham dealers left will continue to advertise in *QST*, thus showing their continuing support for the League, just as the whole ham industry did 30 years ago when the League put 85% of the retailers and manufacturers out of business within a couple of years. There isn't the slightest hint that anyone in the ham industry has leared anything from history.

Your First QSO!

I'll bet you can remember your first contact, just as I remember mine. Oh, I'm not counting the times I used fictitious calls and made contacts on 40m CW (called bootlegging in those days). No, my first legitimate contact, license in hand, was on 2-1/2 meters.

The rig was a 1G4GT oscillator-super-regenerative detector, with a 1Q5GT modulator-amplifier. The whole works was built into a one cubic foot walkie-talkie, complete with batteries and a handle. It was a

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Number 78 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

More Monitors

Last time, we were investigating the repair of hamfest-procured computer monitors. We got as far as replacing the horizontal output transistor. Let's take up where we left off:

Why?

Before we move on from the horizontal section, it would be a good idea to ask just why those output transistors blow out. As I mentioned, they work very hard, and at fairly high voltages and currents. Those factors alone are enough to ensure higher-than-average failure rates. In many cases, the transistor can be blown without the monitor's having any other problems. Sometimes, though, it isn't that simple.

A while back, I ran across a monitor with an odd problem. It was stone cold dead and, sure enough, the horizontal output transistor was popped. A new one brought the set back to life, with a pretty decent picture. Case closed, right? Well, not quite. The seller had been honest and told me that he'd replaced that same transistor just a few weeks earlier. The set had worked for those few weeks and then died again. What was taking out the transistors?

One touch with my finger told me the answer. The heat sink was *hot!* Of course, dissipating heat is the purpose of a heat sink, but this was ridiculous. Within one minute of turning the set on, you could have fried eggs on that aluminum sheet. Heck, my stove doesn't work that fast! (By the way, if you're going to try this test, be darned sure that heat sink is at ground potential first—some of them have serious voltage on them and will give you a lot more than a burn.) What could be causing the heat sink to get so hot, especially considering that the darned monitor worked?

Clues

I was puzzling over this when I took a good look at the screen. The picture looked pretty nice, but the image was a little squashed at the edge; the horizontal linearity was poor towards the right side of the scan. Did that mean anything? I visualized the horizontal current waveform driving that scan. Knowing that TV images are scanned from left to right (as viewed from the face of the tube in the normal position), I realized that the right side of the screen is reached when the current through the yoke (magnetic deflection coils) is at maximum (when the transistor is working the hardest, and its input is at maximum). That non-linearity meant distortion of the scanning waveform. But what would make it distort? Transistors become non-linear when they reach their minimum and maximum limits of amplification. Rather than simply cutting off completely or swinging to the full supply voltage, they begin to amplify less. This occurs only over a very narrow region. Since I knew the transistor was distorting at its maximum point, that suggested that it was being overdriven, out of its linear region. However, if the drive signal were simply too big, the image should have been too wide, perhaps even off the screen. If anything, this one was a little narrower than it should have been. Only one thing was left: the bias had to be too high. In other words, the DC level on the transistor's base had to be too high, causing the transistor to conduct too much, and driving it out of its linear region. That sure would explain the heat!

A quick glance at the circuit board, however, showed that there were no bias resistors going up toward the power supply. The only resistor was from the base to ground. Could it be bad? It checked out right on the money. What else could supply DC to the base of the transistor? Hmmm, there was an electrolytic capacitor coupling the signal to the base. If it were leaking, it might leak some DC from the previous stage, raising the bias. I put in a new cap and, *voila*, all the symptoms went away! The heat sink stayed at finger-touch levels, and the distortion in the scan disappeared. The monitor has worked fine for over a year now. Case closed.

The moral? Sometimes those transistors really do have a reason for blowing out! Usually, though, they just go.

Consequences

Last month, I mentioned that the horizontal outputs generally fail open, not shorted. In hindsight, I think that's not strictly true. What probably happens is that they do indeed short, and all that current going through them then blows them open. But, for perhaps a second or two, they're pretty much a dead short to ground. So what?

That scenario explains the power supply failures often associated with blown horizontal outputs, that's what! Very often, you'll find a blown fuse, which is what leads me to suspect the temporary short; an open circuit won't blow a fuse! Sometimes, there's more damage. Frequently, the power supply is damaged, and replacing the fuse results in another blown one within milliseconds. *Now* what?

Usually, the problem is another blown transistor! Most monitors use switching power supplies. Those things operate at high frequencies, and they work quite hard. In fact, they're a lot like horizontal circuits. Just about every personal computer out there uses one, and millions of them are humming along, year after year, with no problems. So, why do they die in monitors? Many computer supplies have built-in short-circuit protection, and will simply stop and start until the short is removed, with no damage. If you've ever heard a computer supply go "squeak squeak" or "tick tick," you know what I'm talking about.

Monitor supplies, though, rarely have such protection. When a short is placed at the output, the fuse blows. Shouldn't that protect the supply? Yes, but anyone who's spent much time working on solid state gear knows that transistors often wind up protecting fuses! In a monitor, the usual victim is the supply's switching transistor. Like a horizontal output, it's attached to a heat sink. It may be bipolar or FET, but you must replace it with a compatible part; most general-purpose transistors can't take the voltages encountered in these circuits.

Be sure to replace the switching transistor *after* replacing the horizontal output; if you do it the other way, you may just blow the switching transistor all over again, faster than you can shut off the power. Yet another word of caution: Switching power supplies are especially dangerous to service. That transistor is not isolated from the AC line, and touching it is no different from sticking your finger in a lamp socket! Be sure to unplug all power and discharge the supply's electrolytic capacitors before attempting to change the transistor.

Your monitor should be working now! If not, it could have other, more serious problems. If the fuse still blows, there's another short somewhere. Unfortunately, a likely candidate is the high-voltage transformer, or "flyback." Especially on old sets that have been on for thousands of hours, this part can break down. The flyback is what generates that 30,000 volts, so you can imagine the stress on the insulation separating its thousands of windings of very fine wire. Also, there's an integral high-voltage rectifier, and that can short out, too. Testing for a bad flyback isn't easy, because the windings may break down only when high voltage is applied to them, but if the flyback shows burn marks, there's a good chance it's the culprit. I have seen some pretty ugly ones that still worked, though. If the horizontal output blows again as soon as you apply power, suspect that flyback. The unfortunate part is that flybacks are expensive and, unless the monitor is particularly valuable, you won't want to invest the money to try a new one in a set which could still have other problems. Usually, a bad flyback means a ruined set.

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HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton CA 92633

Doppler Antenna Update

"What's the best equipment for winning 2 meter T-hunts?" That's the question I am asked most frequently by hams contemplating their first search for a hidden transmitter. As you might expect, there is no simple answer. I have seen the VHF radio direction finding (RDF) setups of hundreds of hams and they're all somewhat different, just like snowflakes.

To narrow the field, let's presume you're preparing for a beginners' mobile T-hunt. You will probably have to drive at least 10 miles, so you need an RDF setup that mounts on your car so you can find the signal direction while moving along. You don't want to be constantly stopping and getting out to take bearings. This eliminates the "body shielding" technique and simple "bat-wing" buzz-box attachments for your handie-talkie.

The favorite mobile RDF antennas in my area for the bands from 144 to 450 MHz are homebrew quads of three to six elements. Yagis of the same boom lengths are also common. No RDF device in the ham market has more sensitivity than a simple yagi or quad and nothing works better when the hidden signal is horizontally polarized. That's why Southern California hams prefer this method; weak signals are common on our hunts. Of course, a rotating four-element quad is a bit cumbersome to mount on a car, but that's what almost every hunter does.

On the other hand, the T-hunting conditions in your area might be more like those in Phoenix, where hiders usually put out strong signals with vertical polarization. You can use a beam there, as many do, or you can use another popular RDF method that's based on the Doppler effect.

Typical Doppler RDF sets for VHF have from three to eight equally-spaced quarter-wave vertical whips arranged around an imaginary center point on a ground plane. An RF switching circuit connects whips to the narrow-band FM receiver, one at a time in sequence. This makes the receiver think it is connected to a single whip that moves in a circular path around this imaginary center point.

When this pseudo-rotation is done at high speed (approximately 500 times per second), the Doppler effect causes frequency modulation to appear, superimposed on the received signal's audio. It sounds like a tone at the array's spin frequency. The phase of this tone, relative to the whip switching sequence, is processed to determine the direction of the incoming signal. Doppler bearings are usually displayed on a ring of eight to 32 light-emitting diodes. The number of LEDs is independent of the number of whips.

Doppler sets are appealing because they provide instant bearing readout. They are great for tracking short transmissions because they update the bearing many times per second. Since they have no moving parts, Dopplers are easy to install and use on almost any vehicle. RDFers involved in volunteer enforcement like them because they are much less conspicuous than beams. One of the most popular designs for hams is the inexpensive Roanoke Doppler (see sidebar).

Is the Doppler Working?

A lot of my e-mail in recent months has been about my new wideband antenna switching circuit for the Roanoke Doppler. It uses PIN diodes at each end of the four whip coaxes to improve isolation and control impedance at the whip bases. Plans for it are in "Homing In" for April and June 1995. If you missed it, I'm sure the folks in Peterborough have back issues to sell. For the most part, everyone who has written is enthusiastic about its performance.

Jim Baremore K5QQ sent some pictures of his version made from Hustler UGM magnetic-mounts (Photo A). They cost about the same as the CB mounts that I used and he says there is plenty of room to add the resistor and PIN diode in the base. You'll find these mounts at many ham radio stores.

Some correspondents noted that mobile Doppler indications on 440 MHz signals fluctuate much more than on 2 meters. This is normal. RDFers who hunt both bands have seen this phenomenon with both beams and Dopplers. It occurs because multipath becomes more prominent as you go higher in frequency.

Multipath causes several apparent simultaneous bearing directions due to signal reflections from buildings and other nearby terrain features. Since the ability of a surface to reflect a radio signal is proportional to its size and smoothness in terms of wavelengths, there are far more objects around that will reflect 70 centimeter wavelength signals, compared to signals of 2 meter wavelength. The best way to combat multipath is to keep moving and "eyeball average" your direction indications as you go along.

It's always best to verify proper operation of any RDF setup before going out to hunt a signal in an unknown location. The obvious way to check your Doppler would be to take a quick walk around the car with a transmitting hand-held, watching the LED display to see if it follows along. But this is not a reliable method, particularly on UHF. A perfectly good antenna system is likely to give bad results, for two reasons. First, the display electronics and switcher diode currents may be upset by the intense RF field from the HT.

More important, a Doppler array is designed to work with a "planar" wavefront in the "far field," to use some terms that $100-an-hour antenna engineers like to toss around. Put more simply, the wavefront coming off your HT's "duckie" is a circle that expands outward. It's just like the ring of ripples you get when you toss a rock into a still pond. When the transmitter is very close to the receiver (in the "near field"), the part of the wavefront that strikes the receiving antenna has a lot of curvature to it. When the T is many wavelengths away ("far field"), the wavefront circle has become so big that the segment reaching the receiver has very little curvature and appears to be planar.

Another factor to consider is that Doppler accuracy can be degraded by proximity to anything that disrupts the planar characteristic of the incoming wavefront. Other communications antennas on your car may "pull" the Doppler indication in their direction. The effect is most detrimental when whips are in front of the Doppler array or when you have a rotatable beam mounted on the car.

When correspondents tell me that their Dopplers just don't seem to work right, I urge them

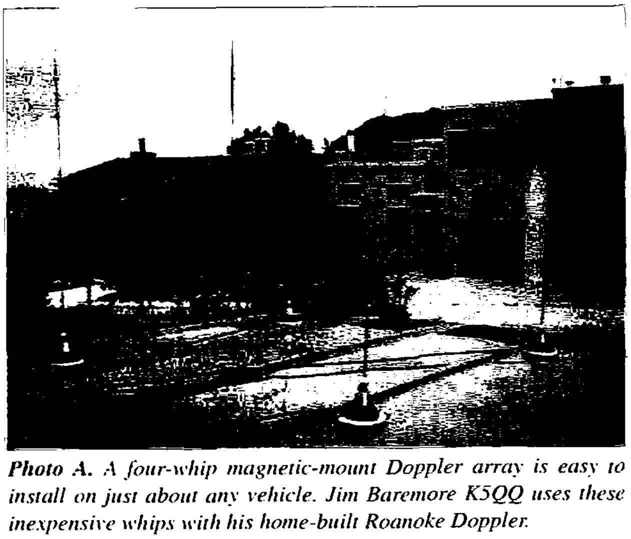

Photo A. A four-whip magnetic-mount Doppler array is easy to install on just about any vehicle. Jim Baremore K5QQ uses these inexpensive whips with his home-built Roanoke Doppler.

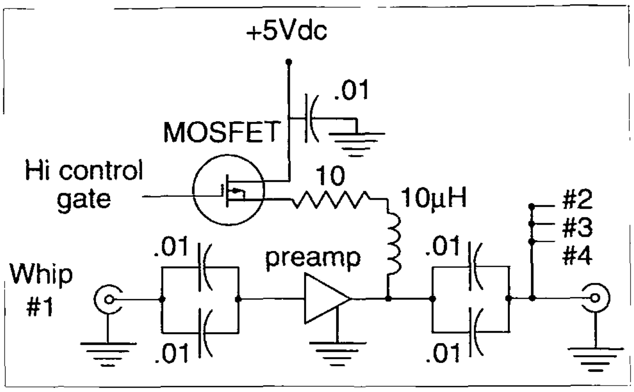

Figure 1. Schematic of the Doppler switcher/preamp designed by Jim Sorenson KA4IIA. All four preamps are identical, so only one is shown. All capacitors are surface-mount chip types.

to check over their antenna system very carefully. Then I recommend having another ham check to see if there is something they are consistently missing. Murphy must like Doppler arrays, because there are lots of ways to make mistakes in hooking up a switcher. Besides the usual shorts to ground and bad connections, I have seen units with reversed wiring of logic lines, two logic lines shorted to one another, failed PIN diodes due to overheating during soldering or accidental high-power transmissions, and incorrect placement of whips on the vehicle.

An oscilloscope is the best instrument for checking antenna set switching waveforms, but you can often find a failure or wiring error with just a digital voltmeter. To check your wideband Roanoke Doppler switcher quickly, verify the +3.5 VDC bias on the shell of each coax connector with respect to circuit ground. With pseudo-rotation turned on, the average DC voltages on the four whip rods should be within 50 millivolts of each other. Voltages at the inductors (L101-L104) should also be within 50 millivolts of each other. On the other hand, voltages on the center conductors of the four coaxes (between the series PIN diodes) may not be equal even on a working unit due to minor differences in diode leakage.

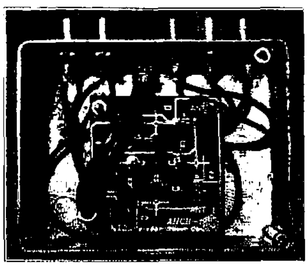

Photo B. KA4IIA's switcher is laid out on a 2-1/2 inch square board. The MOSFETs and RF chokes are visible. Monolithic amplifiers are on the other side.

I regularly check my Doppler's operation by taking bearings on a repeater atop Mount Baldy. One day I observed that the display did not track the repeater as usual. It just bounced around in one quadrant of the display, no matter which way the car was traveling. I checked the DC whip voltages and noticed that one was different from the others. Sure enough, a resistor lead in one antenna base was poorly soldered (oops!) and had lost contact, keeping the two PIN diodes in series with that whip from conducting. On another occasion, a voltage check caught a short from coax center conductor to shield at a whip base.

A Switcher With Gain

Over the years, Doppler users have looked for ways to overcome the inherent RF losses of antenna switching circuits. Jim Sorenson KA4IIA began experimenting with monolithic RF gain blocks from Mini-Circuits Laboratories in the antenna switcher of his Roanoke Doppler about six years ago. He found that these tiny preamps are manufactured to very close tolerances, so the signal phase shift through each of the four whip channels can be made nearly identical. This is very important because any difference in phase or time delay will adversely affect bearing accuracy.

Jim selected the MAR-4 amplifier, which has 8.2 dB specified gain in the 140 to 450 MHz range. Specified noise figure is 7 dB. Fig. 1 shows the schematic of KA4IIA's antenna switch, which has a separate monolithic preamplifier for each whip. Selection in sequence is done by keying each MAR-4 on and off with Zetex ZVP-4105A metal-oxide semiconductor field-effect transistors (MOSFETs), available from Digi-Key. Circuit layout must be done carefully such that path length through each of the four preamp channels is exactly equal. The best way to control path length is to use an etched board, as Jim did.

I was eager to compare Jim's antenna switcher against my wideband PIN diode switcher. I tested both in my T-hunt van and I also measured overall sensitivity of each on the bench with a calibrated VHF/UHF signal generator. I use a Regency MX-7000 continuous coverage scanner for receiving with my Dopplers, because I want to be able to perform RDF on any frequency from 120 to 500 MHz. It has 0.2 microvolts for 10 dB FM quieting sensitivity in this frequency range. That's more sensitive than many other scanners, but not nearly as good as most ham-band mobile and hand-held receivers of this decade.

When I fed the 146.565 MHz signal generator output though each of the two switchers (with rotation stopped), I discovered that the MX-7000 could detect a 7.6 dB weaker signal with the KA4IIA switcher than with the new Roanoke PIN switcher, for the same amount of quieting. This approximates the gain of the MAR-4 amplifier stage, with coax losses.

Does this mean that you can gain enough sensitivity to double your Doppler's range by simply changing from a PIN switcher to one with MAR preamps? Not necessarily. The receiver you use makes a big difference, as I found when I replaced the MX-7000 scanner with my IC-32AT hand-talkie and repeated the sensitivity measurements. The IC-32AT has a much "hotter" receiver, giving 10 dB quieting with only 0.125 microvolts at the antenna jack. With it, the Doppler sensitivity difference between the two switchers was only 2.3 dB. This makes sense when you realize that the noise figure of a MAR-4 preamp is not nearly as good as that of the IC-32AT front end.

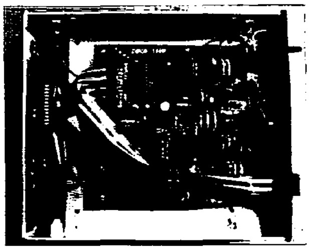

Photo C. Processing and display electronics are on separate boards in the Directional Systems Doppler unit.

In summary, changing to Jim's switcher circuit will give an overall sensitivity boost of 7 dB or so if the receiver in your Doppler setup is average. But the improvement will be much less if you're using a receiver with high sensitivity and an excellent noise figure with your Doppler. With a "hot" receiver, it may be difficult to tell the difference in sensitivity when T-hunting. My on-the-road experiments confirmed this.

Over the years, KA4IIA has built about two dozen antenna preamp/switchers for hams in his area, with help from Andy Glass WD4MYL, who helped test the circuit and write the documentation. Jim has formed his own company, Directional Systems, to distribute his Doppler products. They are popular with ham balloon trackers in the Atlanta area. According to KA4IIA, multipath isn't a big problem when the target signal is coming from a parachute payload thousands of feet in the air. "When it's above you, the Doppler just locks in solid," he says.

Jim's preamp/switcher covers the 2 meter, 125 cm and 70 cm bands, requiring whips of appropriate length and spacing for each band. In addition to the switcher (Photo B), he also sells a set of two circuit boards for Doppler processing and display, based on the Roanoke design. These high quality boards are double-sided with solder mask and silk-screen

markings for each component (Photo C). A matching enclosure is also available (Photo D). Depending on your home-brewing abilities, you can buy bare boards, board/parts kits, or fully assembled/tested Doppler sets from Directional Systems. Write to the address in the sidebar for prices.

Directional Systems kits and boards include detailed parts lists and assembly instructions. Completed units have a professional look. The biggest gripe I had after testing Jim's version of the Roanoke Doppler was that the direction-indicating LEDs are quite small. The front panel does not include the scan-stop switch and indicators for Low Signal and Overload, but they can be incorporated by drilling some more holes and adding the parts.

Keep the letters and e-mail coming with your experiences using all kinds of RDF equipment. I still occasionally experience short-term e-mail outages, so if you're expecting a reply and don't get one within two weeks, send your message again. E-mail goes to: Homingin@aol.com on Internet or 75236,2165 on CompuServe. Send postal mail to the address at the beginning of this article.

This Month's Resources

Directional Systems
P.O. Box 81881
Conyers GA 30208-9426
E-mail: ka4iia@radio.org

Mini-Circuits Laboratories
13 Neptune Avenue
P.O. Box 350166
Brooklyn NY 11235
(718) 934-4500

Digi-Key Corporation
701 Brooks Avenue South
P.O. Box 677
Thief River Falls MN 56701
(800) 344-4539

Complete plans for the basic Roanoke Doppler RDF set with single-band PIN diode antenna switcher are in *Transmitter Hunting—Radio Direction Finding Simplified* by Joe Moell KØOV and Tom Curlee WB6UZZ. This 323-page reference book (TAB/McGraw-Hill #2701) covers all aspects of RDF and is available from Radio Bookshop.

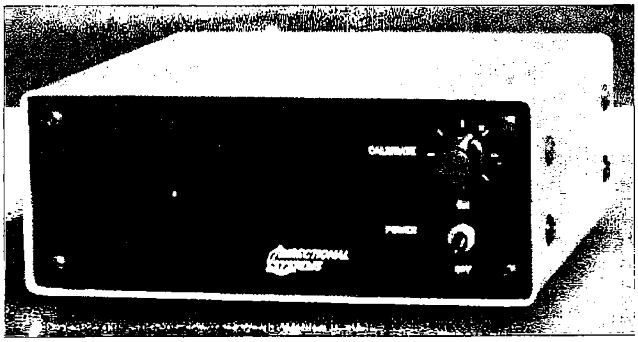

Photo D. The complete Directional Systems Doppler display is in a 7-1/2 x 6-1/2 x 2-1/2 inch enclosure.

Never Say Die

Continued from page 77

circuit from *Radio* magazine, which ran circles around *QST* in those days when it came to fun building projects. And we all built our own transmitters. Heck, we had to, since almost none were available commercially until well after WWII.

Hams originally built their own receivers, but then the day after the first commercial receiver came on the market, they stopped building them. I wasn't there when it happened, but it was about the time the National SW-3 arrived. Many hams I visited were still using the SW-3 in the late 1930s.

My first contact was with W2MSV, Dexter Miller. Dexter was mostly active on the 160m and was forever discussing which new receiver he was going to buy. But he couldn't make up his mind and eventually died without ever having enjoyed his dream. Dexter had a generous stomach and smoked, so he didn't make it much past his early 50s.

Yes, my first contact was made with me carrying my walkie-talkie, walking down the hill in Troy, New York.

Actually, I got my license almost by accident. I'd tried a couple of times, but through panic had failed the 13-per code test. Then a friend asked me to go along with him while he took the test. Why not? So I practiced my code for a few minutes the night before, but I didn't expect to pass, so I didn't bother looking at the Q&A manual.

My friend sat behind me during the test. I couldn't believe how easy the code test was! I had no problem copying it 100%, but that was because I'd expected to fail, so I wasn't tense or stressed. When it was over my friend had almost a blank paper. Yet the night before he was copying 15-per with no trouble. He never did get his ham license and we lost an excellent and creative engineer. He later opened a well-known audio laboratory in New York.

I was also active from the college dorms on 2-1/2m with a regenerative receiver I'd built and a pair of 76s with a long-line tank circuit. And on 160m with a T-125 final. Boy, did that raise Cain with the little AC/DC broadcast radios around the dorms. I had to operate mostly after midnight. Well, that's when you work the best DX on that band anyway. I won the 1941 Sweepstakes for my section just on 160m! And I was talking away on 160m on December 7th 1941 when I got word from a ham in western New York about Pearl Harbor. We were put off the air that same day, with W1AW chasing everyone off.

Well, Have You Read It Yet?

Several hundred *73* readers have read my book, *Declare War*. Alas, several thousand haven't…an egregious, inexcusable and disappointing oversight.

In it I propose a simple, inexpensive way to cut our American prison costs by at least 90%, while at the same time providing unlimited prison space and an actual re-education for the inmates. With 1.1 million Americans in prison, and at a cost of around $30,000 a year each, that's $33 billion going down the tubes just because we're too lazy to change our prison system. I also propose a painless way to cut the costs of our federal, state and local bureaucracies by 50% within three years. It's a bureaucracy that has a larger labor force today than is working in manufacturing. Then there's a novel way out of our welfare misery: a way to cut crime by at least 80%, and so on. I've been getting wonderful letters from people who've read the book. You know, I haven't had one letter yet saying my creative approaches to these currently insoluble problems won't work. They just want to know how come Clinton hasn't read the book. Or Perot.

This all started almost three years ago when Governor Gregg (now Senator Gregg) called and asked if I would serve on a New Hampshire Economic Development Commission. Since around 30 other businessmen and politicians had been tapped for the "honor," I explained that I would probably be more of a trouble-maker than the others combined. I was right.

It didn't take very many Commission meetings for me to discover that precious little would ever be accomplished with 30 people sitting around a big table. That meant that while one pontificated at length, 29 sat there not listening to what was being said because they were busy thinking about what they wanted to say, should they ever get a chance. Naturally we made zero progress.

So we split into subcommittees, each of which held hearings. I attended as many of these as I could and asked endless questions. The experts we invited in to testify did their best to explain their problems and failed solutions, and then gave me lists of books to read so I could learn more. I read 'em. I read a couple hundred books over the next two years, and I'm still at it in every available moment.

The Commission was formed because New Hampshire was suffering by far the worst of all 50 states from the recession. The Governor and the Legislature said they were looking for guidance, but they salted the Commission with enough politicians to eventually sink it without leaving a ripple…except for my reports. The Commission never even handed in a final report. The meetings just sort of quietly petered out.

Once I had a good grasp of the main problems facing New

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Ham to Ham

Continued from page 60

another suggestion to make remembering Herb's tip easier: Make up a cardboard card with a schematic diagram and description of Herb's testing steps on it; epoxy a 470 ohm, 1/2 watt resistor to the card over the schematic's resistor symbol. Then when you next need to test an SCR, you'll have all of the info handy (and even the correct resistor!). I've used this method for other little test circuits that I use infrequently, and it's worked well for my not-always-perfect memory!

This ends another month of "Ham To Ham"...and our goal of keeping "Ham To Ham" viable for at least six months. Thanks to all who've submitted their tips, ideas, suggestions and operating procedures; you've made it work. Let's hear from more of you! The more input we have, the longer the column will go on and the more we can expand its scope. Let me hear from you at the address above; sending your suggestions and ideas to 73's offices in Peterborough only delays them since they have to be forwarded here.

We've all run into tips and shortcuts that we wish someone had told us about sooner; that's pretty much what we're looking for in "HTH." Don't be shy, send in anything that you think might have value to others in the hobby. If your writing skills aren't your strong point, don't worry, I'll rewrite your text so it conforms to the conversational style that I'm trying to maintain for "HTH." And be sure to look for a number of good new ideas here next month.

Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73* and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*. deDave NZ9E.

A Simple Capacity

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If you used the specified colorburst crystal, chosen because it is the least expensive surplus crystal available, you have also constructed a signal source which produces known frequency harmonics in or near every ham band from 80 through 10 meters. For this "free signal generator" to be useful to you requires measuring the fundamental frequency with a frequency counter. This will *not* be the same 3.57955 frequency marked on the crystal!

Connect the frequency counter to J1 and J2, with R3 adjusted so its wiper is roughly centered in its range. Note the reading on the frequency counter. Using a calculator, multiply this frequency to determine the exact frequency of each useful harmonic. Keep this list for future reference.

A short piece of wire attached to J1 should allow you to hear the harmonics in your receiver. Because each frequency is accurately known, you can check dial accuracy or use the signals as an aid in alignment, or just tweaking for maximum gain.

Parts List

BT1	9V alkaline battery
C1, C3, C4, C6	0.01 µF disc ceramic capacitors
C2	10 µF 16V electrolytic capacitor
C5	220 pF polystyrene, mylar or dip mica capacitor
D1	Germanium diode: 1N34, 1N60, 1N90, 1N270
J1, J2	Binding post
M1	Meter, 100-300 µA full scale (see text)
R1, R2	560 ohm 1/4W 5% resistor
R3	Carbon potentiometer, 200 to 300 Ohms
R4	1K 1/4W 5% resistor
S1	SPST toggle or slide switch
U1	74LSOO
U2	78LO5
Y1	3.57955 MHz crystal (see text)

A Stealth 40-10 Meter

Continued from page 55

want, but, since you'll be using a tuner so you can use several ham bands, the wire length isn't particularly important.

It 's better to operate from a room other than the one in which your antenna is installed. Why expose yourself to RF if you don't have to? (But this isn't very important if you're running under 50 watts.)

Disclaimer: This antenna may not work well if you have a metal roof (maybe try loading the roof as an antenna); or there is metal mesh holding the stucco on the outer wall; or a metal heating or air conditioning duct runs above the ceiling near your antenna; or Murphy got there first.

Ask Kaboom

Continued from page 78

If the power light comes on and the fuse doesn't blow, but you still don't get a picture when you connect a computer, take a look at the back of the picture tube. If you don't see an orange glow from the filaments, they aren't lighting. Many are driven by the horizontal output circuit, via a fast-recovery rectifier. This is a special part, and an ordinary 1N4000-type part won't work. I recently ran into this problem, and replacing the diode brought the set to life.

Hopefully, your monitor is now fixed. If not, you've got a standard troubleshooting job ahead of you. If the set seems dead, check specifically for activity in the horizontal oscillator circuit; no signal, no high voltage and no picture! On many sets, even the power light is driven from this circuit, and that's a valuable clue. If the power light is on, the horizontal is running! Some sets, though, drive the light from the switching power supply, so follow the wires back to the board to be sure.

Set 'Em Up

Once you get your monitor working, you'll want to adjust it for the best picture. Next time, we'll explore how to set up the focus, screen level and color balance. Until next time, 73 from KB1UM.

Communications

Continued from page 70

and then at the receiver convert it back to the audio or video signal with a *digital-to-analog converter*. This method is currently used in compact discs, in digital audio (such as the WAV files in computers), and in digital radio. It is also now used in telephone systems, for sending voice signals through fiber optic cables, and for an entirely new telephone system called ISDN or the Integrated Services Digital Network. ISDN will eventually provide direct digital connections to your home, which can be used not just for phoning your friends, but also for sending digital data and pictures.

BARC Jr.

by Ben Fenster KBØOVM

What is BARC Jr.? It's the Boulder Amateur Radio Club Junior. Founded in 1993, it is a club for kids under age 18. Today, three years later, it is a club with more than 40 kids ranging in age from 6 to 16. Its purpose is to get more young people into ham radio. This is done by demonstrations, participating in Field Day, and so on. At swapfests, BARC Jr. sells J-pole antennas made by the members, plus donated items, and uses the money to buy kits for the kids to build, buying loaner equipment, funding social events, and most of all, funding an annual Dayton HamVention trip. Every year one member is sent to participate in the Youth Forum. Besides this, there's a class every week where they study the code, have a technical session, and witness a demonstration. BARC Jr.'s 15-20 Elmers teach the Novice through General classes. At some classes operating procedures are covered, such as how to use and what can be said on an autopatch. Once a month a speaker comes in to talk on anything from antennas to repeaters to autopatches. And every Sunday the group gets together on the 146.700 BARC repeater.

We occasionally take field trips to participate in contests or see repeater sites. Once we took a trip to the Big Horn museum in Byers to see old radio equipment. Around Christmas we have a party, every August we have a family picnic and foxhunt, and now and then we have a group dinner.

We also have red BARC Jr. T-shirts, hats and pins, and various other things are sure to come up soon. As you can see, BARC Jr. is a well-identified club.

This year at Field Day we had a visitor. Wayne Green was in the area and stopped to see our Field Day activities, and asked for an article about BARC Jr. I am the editor of "Yip Yap" (the BARC Jr. section in BARC Sr.'s newsletter), so I was given the job, and here is the finished product.

Kelly Woo KE6KJU was featured in the cover picture for the July 1995 Radio Fun which had an interesting article on page 12 written by KN6MG about her. Kelly convinced her dad, KN6MG, that she wanted to get her ham license. Kelly dropped by the 73 booth on the Queen Mary and had her picture taken with W2NSD/1. The article is in Radio Fun #47 and is available postpaid for $4 from Radio Book Shop (order form on page 88.)

QSL Contest

Did you buy your QSL off a rack,
or did you put some thought
and creativity into it?
If you think you have a winner,
send it in and let us have
a look at it. Who knows, it might make the cover.
Well, maybe page 85 or so.Or maybe Wayne's wastebasket.
If it's declared a winner, you'll get a CD
of your choice of any of 26 kinds of music, as listed in Wayne's
November editorial. You'll also see it in 73! Send it to
QSLContest, 73 Magazine,
70 N202, Peterborough NH 03458-1107.
Bribery?
You Bet!

Dots and Dashes

Hal Goodman W3UWH
Box 942
Bala Cynwyd PA 19004

As I think back over the nearly fifty years I have spent as a ham, few things seem as thrilling as my first few CW contacts on 80 meters. My very first contact was with a ham who lived only two blocks away. I had made arrangements with him at the local radio club meeting as to time and frequency. I only had one crystal, so picking the frequency was easy. As the time approached, I plugged the eighty meter coil into my three-tube super-regenerative receiver and turned the power on to my two-tube (rectifier and oscillator) transmitter. My transmission was only at about four or five words a minute and filled with many errors. However, he was very patient and I was able to complete the contact.

Today, I frequently tune the eighty meter Novice frequencies and really enjoy helping some youngster feel the thrill of making a CW contact. Even though many people today say that CW is obsolete and should no longer be required, it is an accomplishment. After all, being able to communicate by CW is something that 99.965% of the world's population cannot do. And, besides it's fun.

I was talking with a youngster recently who told me he had just gotten his ticket and that I was his third contact. He asked how long I had been on the air and when I told him, he asked what class license I held. When I told him that I was an Extra Class, you could almost hear the excitement as he asked if that meant he could send faster. When I said yes, he started sending faster, though the first thing he said was, "Don't you send faster."

However, there is a down side for us old timers when it comes to working today's new hams. Our reflexes are not as fast as they used to be. You might ask, what do reflexes have to do with copying CW? It's not the copying, it's the trying to make sense out of what you are copying quickly enough to understand what is being said. Most youngsters are in too much of a hurry to build their code speed up to where they can pass the code test, and then never have to use code again. They are not willing to put in the time and effort to develop a "good fist." Instead, they get an electronic keyer, thinking it will make up for their lack of skill.

> ***"Relax, there is nothing more enjoyable for most of us "old timers" than joining in the excitement a new ham experiencing the joys of ham radio."***

Unfortunately, it only makes matters worse. Let me give you an example. About two weeks ago, I made contact with a Tech-plus op. I looked him up later and found his name was Bill. What follows is an exact transcript of what I copied. Only the call sign is omitted to protect the guilty.

"W3VWH/lt di N2— fb om dami is 6anl. buel. qt5 is roc5ehtil, ny rochismir, ny ur rht 58e9e rsm 5891, ho bx tu 6k"

No, I'm not kidding. That is exactly what I copied. I may be getting senile, but I can still copy ten words per minute accurately. He was using one of those electronic keyers without knowing how to use it. The key speed must have been set for at least 25 words per minute. Now had I been younger and had faster reflexes I might have been able to ignore the extra dots and occasional extra dashes. As it was, he seemed to have turned it back to me and I was sitting there looking at what might as well have been hieroglyphics. What do you answer? 'N2— de W3UWH/1 severe lightening, must QRT immediately, 73 de W3UWH/1."

Back in the old days, when you took your code test you had to both copy and demonstrate your ability to send code. Speaking for us senior hams, arthritis and all, I think we should reinstate that requirement. Let those who don't want to do code content themselves with no-code Tech licenses or type their messages on the Internet.

Another area of CW communications that is becoming lost, is the ability to use the English language. Now don't get me wrong, I have no objection to, "fb om es tnx for the qso." It's when the messages start to look like, "tnx it wznce of u to ans my cl, sd cpy. rghr knwd to a bazk up 40f, rn 70wts." Yes, I know we can all take a minute and figure out what was sent. But the purpose, for me at least, in making a CW contact is to enjoy the experience, not a test of cryptography skills. It seems that the current crop of new hams is laboring under the misconception that if they don't abbreviate absolutely everything, they will look foolish. It reminds me of the time when as a youngster, before my voice changed, I would practice trying to talk in a deep voice, because I wrongly believed that no "old timer" would talk to me if he thought I was a kid.

Relax, there is nothing more enjoyable for most of us "old timers" than joining in the excitement a new ham experiencing the joys of ham radio. Most of us are retired or at least have lots of spare time and you don't need to rush. Take your time, develop a "good fist," and only use common radio abbreviations. If you do that, then there will be no "generation gap" within the ham fraternity. 73

Number 86 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

MAR 2

BISMARCK, ND The Central Dakota ARC will hold its annual Hamfest at the Radisson Inn, 800 South Third St., 8 AM–4 PM. Talk-in on 146.85/.25. VE Exams and Ham/Computer Swapmeet. Call *Tim N0SDB, (701) 663-6620.*

COMER, GA The 1st annual Bubba Hamfest, sponsored by the N.E. Georgia Bubba Net, will be held 9 AM–3 PM at the Madison County Fairgrounds, 1/2 mi. south of Comer GA, on Hwy. 22. Talk-in on 147.315(+). Dealers indoors and covered Flea Market, VE Exams. Set up and camping available Fri. night. For reservations and info contact *Dan Daniel AE4HS, 152 Windfall Dr., Winterville GA 30683. Tel. (706) 742-2777.*

TWIN MOUNTAIN, NH The North Country ARC and Littleton ARK will host their 3rd annual Ham Radio and Computer Flea Market, to benefit the North Country D.A.R.E. Program. The event will be held at Twin Mountain NH Townhall, near the intersection of Routes 2 and 3. Setup at 8 AM, public admission 9 AM–3 PM. Bring your own tables. For more info, contact *Richard Force WB1ASL, 12 Cottage St., Lancaster NH 03584-1903. Tel. (603) 788-4428. E-mail r_force@moose.ncia.net.*

MAR 3

CLEVELAND, OH The Cleveland Winterfest will be held at the Cuyahoga County Fairgrounds in Berea OH, 8 AM–2 PM. VE Exams; have proper IDs, copy of license, and $6.07 check payable to ARRL/VEC. DXCC/WAS QSL Checking before 10 AM. Talk-in on 146.73. Write to *Don Ritchie K8ZGW, Hamfest Assn. of Cleveland, P.O. Box 81252, Cleveland OH 44181-0252;* or call *(216) 999-7388* in Cleveland, elsewhere *(800) CLE-FEST.* Leave message on pager.

MAR 9

VICTORIA, TX Victoria Swapfest 1996 will be held by the Victoria ARC at Knights of Columbus Hall, 3610 N. Ben Wilson. Door opens at 8 AM. VE Exams begin at 9 AM. General admission is not required to take the exams. Talk-in on 145.190(-) or 145.130(-) (PL 103.5). For tables and info, contact *Victoria ARC, 121 South Main St., Suite 205, Victoria TX 77901. Tel. (512) 573-0821.*

WEST PALM BEACH, FL The West Palm Beach ARC will hold their semi-annual Free Flea in John Prince Park, Lake Worth FL, at Mound Circle, 8 AM–2 PM. Free to buyers and sellers. Talk-in on 147.135 (+600). Contact *Marvin Kaskawits KD2CK@KB4VOL. Telephone (407) 683-2930 p001471b@pbfreenet.seflin.lib.fl.us.*

MAR 9–10

CHARLOTTE, NC The Mecklenburg ARS Hamfest and ComputerFair will be held at The Charlotte Merchandise Mart, Liberty Hall. Setup times: Dealers and Manufacturers: 9 AM–9 PM Fri.; 7 AM Sat. Flea Market Dealers 3 PM–9 PM Fri., 7 AM Sat.; Flea Market Individuals: 5 PM–9 PM Fri., 7 AM Sat. For info regarding space availability, call *Ken Boyd or Jim Crisco at (704) 377-8873.* A copy of your NC Sales and Use Tax license will be required prior to exhibit.

MAR 10

BRISTOL, CT The Insurance City Rptr. Club annual Hamfest and Flea Market will be held at Bristol Eastern H.S., King St., 9 AM–1 PM. Snow date is Mar. 17th. VE Exams at 10 AM by pre-reg. only. SASE to *ICRC, P.O. Box 165, Pleasant Valley CT 06063.* For Flea Market reservations, contact *Pete Brunelli, 358 Andrews St., Southington CT 06489. Tel. (860) 620-0176.*

WAUKESHA, WI The SEWFARS Rptr. ARC will hold a Swapfest at the Waukesha County Expo Center, 8 AM–2 PM. Talk-in on 146.82/.22 PL 127.3 Hz. VE Exams, bring original license. For info call *(414) 650-0724,* or write *SEWFARS, P.O. Box 102, Delafield WI 53018.* Reservation deadline is Feb. 23rd.

MAR 16

WESTBORO, MA The Minuteman Rptr. Assn. (MMRA) will hold their Ham Radio Flea Market at the Westboro H.S., 90 West Main St., 10 AM–2 PM. Setup 8 AM–10 AM. Contact *Andy N1BHI, (508) 489-2282.* Talk-in on 146.61(-), 146.82(-), 449.925(-), 223.94(-), 224.70(-). Walk-in VE Exams (ARRL-VEC) at Noon (tentative).

MAR 16–17

FORT WALTON BEACH, FL The Playground ARC will hold their 26th annual North Florida Ham/Swapfest at the Ft. Walton Beach Fair Grounds, Sat., 8 AM–5 PM; Sun., 8 AM–3 PM. Indoor Flea Market. Call *Bud K8YNU, (904) 243-5404, 9 AM–5 PM CDT;* or *Scott KE4BFT, (904) 244-3182* for tables. For RV space only, call *Roberta* at *(904) 862-0211.* Commercial space, meetings, forums. Address inquiries to *P.A.R.C., P.O. Box 873, Ft. Walton Beach FL 32549.*

MIDLAND, TX The Midland ARC will hold their annual St. Patrick's Day Swapfest 9 AM–5 PM Sat., and 8 AM–2:30 PM Sun., at the Midland County Exhibit building. Indoor Flea Market, Covered outdoor Flea Market. T-hunts, VE Exams 12 PM on Sat. Contact the *Midland ARC, P.O. Box 4401, Midland TX 79704,* or by E-mail: *oilman@marshill.com.*

MAR 17

MAUMEE, OH The Toledo Mobile Radio Assn. will hold their 41st annual Hamfest/Computer Fair from 8 AM–3 PM at the Lucas County Rec. center, 2901 Key St. For details send SASE to *TMRA, P.O. Box 273, Toledo OH 43697-0273;* or *Robert N. Hanna K8ADK, 2154 Circular Rd., Toledo OH 43614-4205. Tel. (419) 382-2529.*

MONROEVILLE, PA The 24th Two Rivers ARC Hamfest/Computer Show will be held at ExpoMart, 8 AM–3 PM. VE Exams, pre-reg. required one week before tests. Talk-in on 146.13/.73 and 147.72/.12 Rptrs., and 146.52 Simplex. For info, write to *Two Rivers ARC, Inc., P.O. Box 225, Greenock PA 15047;* or FAX *William Hetrick & Assoc., (412) 754-0562.*

YORK, PA The Keystone VHF Club will host a Hamfest/Computer Show at Dover Fire Hall, Rt. 921 (Canal St.), in Dover PA, 8 AM–4 PM. VE Exams at 10:30 sharp, Log House Rec. Area, 2481 W Canal St. (free parking at testing site, or free shuttle service from the Hamfest). For advance table reg., contact *York Springfest, P.O. Box 266, East Berlin PA 17316-0266;* or call *Ted Rodes KE3SO, (717) 259-8063; FAX (717) 259-7870.*

MAR 18

CLAYTON, MO The annual St. Louis County SKYWARN Severe Weather Observation Training Seminars will follow this schedule: Mon., Mar. 18th, Level 1 at 6:45 PM–10 PM; Wed., Apr. 3rd, Level 1 at 6:45 PM–10 PM; Sat., Apr. 13th, Level 1 at 8:45 AM–12 Noon; Sat., Apr. 13th, Level 2 at 1 PM–4:15 PM; Mon., Apr. 15th, level 2 at 6:45 PM–10 PM. All training is held at St. Luke's Hospital, Education Center, Hwy. 141 North of Hwy. 40-61 in Chesterfield MO. No advance reg. required. All are welcome. Certification provided for R.A.C.E.S. and SKYWARN. For more info, contact *St. Louis County Police, Office of Emergency Management, 7900 Forsyth Blvd., Clayton MO 63105.*

MAR 23

WEST ORANGE, NJ Irvington-Roseland AC will sponor a Hamfest 8 AM–2 PM at West Orange H.S., 600 Pleasant Valley Way (Exit 7 off of Interstate Route 280). All indoors. Amateur Radio, Computers, SWLers, Electronic Hobbyists. Vendors *must* preregister for tables by Mar. 15th. Talk-in on W2QR Rptr.: 147.415/146.415, and 146.520 simplex. For info, contact *Jim Howe N2TDI, (201) 402-6066;* or *Liz Howe N2WGH, (201) 402-6066.*

MAR 23–24

TULSA, OK The 1996 ARRL Oklahoma Section Convention will be located in the Maxwell Convention Center, Downtown Tulsa, Exhibit Hall A, (near corner of West Seventh St. and South Houston Ave.). Indoor Flea Market, VEC Exams Sat. at 1:30 PM; Sun. at 9:30 AM. ARRL forum and HQ Personnel present. Digital Forum. SKYWARN School with the Nat'l. Weather Serv. MARS, AMSAT, DX meetings and more. Talk-in on 145.27(-) and 443.750. Roy Neal K6DUE will be the keynote speaker. For Hotel info, call Doubletree, (918) 587-8000 or Howard Johnson's, (918) 585-5898. Ask about Hamfest rates. Dealer/Flea Market setup Fri., Mar. 22nd, 1 PM–10 PM. Call *Merlin Griffin WB5OSM, (918) 272-3081,* leave a msg., or *E-mail 73564-1063@compuserve.com.* The convention will be sponsored by Green Country Hamfest Inc.

MAR 24

STERLING, IL The Sterling-Rock Falls ARS 36th annual Hamfest will be held at the Sterling H.S. Fieldhouse, 1608 4th Ave. Indoor Flea Market. Radio electronic items, computer and hobby. Dummyload available to test equip. Doors open to the public 7:30 AM Sun. VE Exams, walk-ins only. Please bring original current license plus copy, and photo ID. Talk-in on 146.25/.85 W9MEP Rptr. Contact *Lloyd Sherman KB9APW, Sterling-Rock Falls ARS, P.O. Box 521, Sterling IL 61081-0521. Tel. (815) 336-2434.*

WEST TRENTON, NJ The Delaware Valley Radio Assn., Inc., will host its 24th annual Flea Market "HAMCOMP '96" at Trenton State College Student Rec. Center, 7:30 AM–2 PM. Setup at 6:30 AM. Talk-in on W2ZQ Rptrs. 146.67 (2m) and 442.650 (70 cm). Reserve indoor space before Mar. 17th. Make checks payable to *Delaware Valley Radio Association,* and mail to *HAMCOMP '96, P.O. Box 7024, W. Trenton NJ 08628.*

YONKERS, NY Westchester Emergency Comm. Assoc. will hold "WECAFEST 1996" 9 AM–2 PM at Yonkers Raceway, Central & Yonkers Ave. Talk-in on 147.06/.66. Contact *Tom Raffaelli, (914) 741-6606.*

MAR 30

ELIZABETHTOWN, KY A Hamfest sponsored by Lincoln Trail ARC will be held at the Pritchard Community Ctr., 8 AM–4 PM. Setup Fri. Mar. 29th, 7 PM–9 PM (security provided overnight). For advance reservations, contact *Leon Priest, P.O. Box 342, Vine Grove KY 40175. Tel. (502) 351-4721.* Talk-in on 146.98.

MICHIGAN CITY, IN The annual Michigan City Hamfest/Computer Flea Market will be held 8 AM–2 PM CST at Michigan City H.S., 8466 W. Pahs Rd. Table reservations and info available from *Ron Stahoviak N9TPC, 213 S. Dickson St., Michigan City IN 46360. Tel. (219) 872-6594.*

ORADELL, NJ The Chestnut Ridge Radio Club will hold its annual Flea Market 8:30 AM–2 PM in the Education Building, Saddle River Reformed Church, East Saddle River Rd. (corner Weiss Rd.), Upper Saddle River NJ. Talk-in on 2m 146.955 Rptr. Contact *Andy Woerner K2ETN, (201) 261-3783, FAX (201) 261-1038;* or *Dick Colten K1JMI, (201) 837-0555, FAX (201) 837-2969, E-mail K1JMI @aol.com*

WATERFORD, CT The Radio Amature Soc. of Norwich will hold a Ham Radio Auction at the Waterford Sr. Ctr. on Rt. 85. The Auction starts at 10 AM, setup at 9 AM. Bring your gear to sell (10% commission to RASON). Talk-in on 146.730(-). Contact *Tony AA1JN, (203) 859-0162;* or *Mike N1HFX, (203) 546-9498* for info.

SPECIAL EVENT STATIONS

MAR 10

WATERFORD, WI The 1996 Wisconsin QSO Party, sponsored by West Allis RAC, will be on the air 1800Z Mar. 10th–0100Z Mar. 11th. For rules and info, contact *Mr. Lynn Tamblyn K9KR, 5436 Scenery Dr., Waterford WI 53185, Tel. (414) 895-6574;* or write to *West Allis Radio Amateur Club, Wisc. QSO Party, P.O. Box 1072, Milwaukee WI 53201.*

MAR 16

MACON, GA The Macon ARC will operate W4BKM 1500 UTC–2300 UTC at the 14th annual Cherry Blossom Festival. Phone 7.235, 14.240, and 21.335; CW 7.135, 14.035, and 21.135. For a certificate, send your QSL and a 9" x 12" SASE to *Macon ARC, P.O. Box 4862, Macon GA 31208.*

MAR 23-24

GLENDALE, AZ The Center for Amateur Radio Learning will operate Station KC7LUL 1300Z Sat.–2200Z Sun., in the phone portion of the Novice 10m band, and General 15 and 20m bands. Operation will be in conjunction with HamDaze weekend at the Arizona Science Center. For a certificate, send a QSL and 9" x 12" SASE to *C.A.R.L. P.O. Box 51048, Phoenix AZ 85076-1048.*

VIRGINIA BEACH, VA and **MOSS, NORWAY** The Virginia Beach ARC will operate WA4TGF, and the Moss ARC will operate LA5M, 1400Z Mar. 23–2000Z Mar. 24th, to commemorate the 105th Anniversary of the "Norwegian Lady." CW: 10 kHz up from the bottom of the Novice subbands, and 7.040, 10.120, 14.040. Phone: 3.878, 7.278, 14.278, 21.278, 28.363, 146.550. For a certificate, send QSL and SASE to *VBARC, P.O. Box 62003, Virginia Beach VA 23462.*

MAR 30-31

TIMONIUM, MD The Baltimore ARC will operate W3FT to commemorate the 25th Anniversary of the Greater Baltimore Hamboree and Computerfest. W3FT will operate on 14.240, 7.240 and 146.535 MHz from 1200Z–2000Z Mar. 30th; and from 1200Z–2000Z on Mar. 31st. For a certificate, send a 9 1/2" x 12" SASE, QSL card, and contact number to *The Greater Baltimore Hamboree and Computerfest, P.O. Box 95, Timonium MD 21094.* 73

New Product reviews and reviewers are welcome. Write to Richard at 73.

Number 85 on your Feedback card

HAM HELP

We are happy to provide Ham Help listings free on a space available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full 8 1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully—a 1, for example, can be misread as the letters l or i, or even the number 7. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Can anyone supply me with an operating manual and schematic for a **PAL 200 MDX** 12 volt mobile Linear Amplifier? I will pay a reasonable amount for photocopies and postage. *Al Cikas KA9GDL, 412 Radford Dr., Sherman IL 62684.*

During the past year I have received about a dozen QSL cards stating that the operator copied my call (WN8F) as QSL manager for Paul 9L1PG, from Sierra Leone. In most cases, I have returned the cards stating that there must be a misunderstanding of the call, as I am not, nor have I ever been a QSL manager. I know this is a disappointment for these operators and trust the correct QSL manager for 9L1PG can be copied correctly in the future. *Ken Massie WN8F, 115 Woodlawn Dr., Ironton OH 45638-2355* 73

NEVER SAY DIE

Continued from page 82

Hampshire and America, I tackled each of them and came up with a creative solutions based on things I'd read about or seen working in other countries. Being an entrepreneur, my proposals were for ways to solve problems spending the least amount of money, and for ways to cut our taxes and reduce government. You see, I have this crazy idea that the government should be working for us instead of us for them. It'll never sell, I know.

Instead of trying to break through the endless talkers (though saying little) on the Commission with my ideas, I decided to write reports of what I'd discovered and present my proposed solutions that way. Several of the Commission members were very enthusiastic about my reports, while others said nothing. When I met or called those I hadn't heard from and asked what they thought, they said that golly, they really hadn't had a chance to read my reports yet. They still haven't, as far as I know.

I've reprinted my reports in a book and I'd like to have you read it and start sewing the seeds of my ideas all around the country. The book runs 360 pages and I think you'll find it fun to read. Yes, I do fulminate about the damned Commission members and their inactivity. Heck, half of them dropped out in the first few months, after having contributed little, if anything.

The book has been selling in New Hampshire book stores for $13, or from Uncle Wayne's for $16, including shipping. I'll tell you what, I want you to enjoy the book, so while they last you can get one for $13 postpaid. Further, if you are in any way disappointed, send it back for $13 credit toward anything else Uncle Wayne's Bookshelf has in stock. You can't lose, and you could win big. And so could our country.

The proposals I've made to help New Hampshire are just as applicable to any other state.

20/20 Foresight

After reprinting the first year of my reports in the book I couldn't keep myself from continuing even more reports. 21 of 'em before I slowed down. I should put these into a book too, and probably will, eventually. These reports are packed with more ideas for businesses. How about a way for us to double or triple our foreign aid, but instead of giving the money away to despots who don't even thank us, how about making a huge profit on every aid dollar we spend? You're going to love my proposals. I've written extensively on solutions to our school problems, and on health. While copies last, $10 for the 336 pages.

PROPAGATION

Number 88 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

This month is expected to provide some excellent DX on the HF bands. Good days are distributed throughout the month as shown on the chart, but the Poor days are concentrated around the 4th, 15th and 22nd–25th. The remainder will be Fair or trending. You may also find some geophysical effects on earth and in the ionosphere around the 23rd or 24th.

It appears that Cycle 22 is bottoming out as you read this, and Cycle 23 has already begun. Although it will take a while for solar flux levels to increase significantly, the trend is upward...and rise time of a cycle is faster than decay time...so rejoice!

10–12 Meters

Occasional trans-equatorial F-2 layer openings during daylight hours, with 12 meters to show greater signal strengths.

15–17 Meters

Circuits from the Northern Hemisphere to Africa and South America should open on Good days, and daytime short-skip openings will also be present on Good days. Performance of these bands will be sporadic, but on some days will sparkle.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

Where 10 meters is shown, also check 12 meters. Where 15 meters is shown, check 17 meters too. Where 20 meters is shown, be sure to look at 17 as well. Always check the bands above and below the indicated bands for possible openings to the areas shown. Remember that DX is where you find it, and not always where it is predicted to be.

MARCH 1996

SUN	MON	TUE	WED	THU	FRI	SAT
					1 G-F	2 F
3 F-P	4 P	5 P-F	6 F	7 F	8 F-G	9 G-F
10 F-G	11 G	12 G	13 G-F	14 F-P	15 P	16 P-F
17 F	18 F-G	19 G	20 G-F	21 F-P	22 P	23 VP
24 VP	25 P	26 P-F	27 F	28 F	29 F-G	30 G
31 G						

20 Meters

This will be your most consistent band of choice for DX opportunities from sunrise until after sunset. Expect DX from Northern to Southern Hemispheres with decent signal strengths on most days, and short-skip openings to 2,000 miles as well.

30–40 Meters

DX from just before sunset until shortly after sunrise will provide enjoyment on the Good days. However, be aware of seasonal QRN interfering with weak signals. Signals peak to the east before midnight and peak to the west before dawn. Daytime short-skip will be good out to 1,000 miles or so.

80 and 160 Meters

DX during hours of darkness will be available, but not as prevalent as during the winter months. QRN may become a problem for weak signal reception. Some daylight short-skip on 80 will be present, but none at all on 160. 73

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CANADA $4.95

International Edition

73 Amateur Radio Today

THE ARROW CORNER BEAM

Build:
440 Super J
10-6-2 Loops
Low Band Loops
A Tree Antenna?

Reviews:
TriField Meter
Arrow Corner Beam
Startek Counter
Isotron 80

Special Antenna

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM or Mac formats), carefully checked drawings and schematics, and the clearest, best focussed and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

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REVIEWS

DEPARTMENTS

RADIO FUN SECTION

See Safety Notice on page 88. Very Important!

On the cover: This Corner Beam from Arrow Antenna is reviewed on page 24 by WB9RRT (CB 148/450 Dual-Band Corner Reflector). These antennas are distributed by Antennas West.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Contract: Even the most cursory glance at this text is sufficient to bind you, morally and legally, to take a kid (or kids) along on Field Day, get 'em fired up on amateur radio, and then help 'em get started toward a license. You'll feel good about yourself and our legal cousel won't have to hassle you.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Priorities

A letter from a reader who is embroiled in a pissing contest with a crusty old ham asked my advice on how to handle the situation. Though he will probably ignore me, being caught up in the emotions of his windmill tilt, I suggested it was time for him to sit down quietly somewhere and think over his priorities. With spring here…a time of awakening and renewal…maybe you could do worse than shut the shack door, turn off the rig, and spend some time thinking.

What do you want to do with your life? What goals have you in life? Do you hunger for recognition and honors? Money? Do you have a need to leave the world a little better for your having been here? How about your children? They are one of the best investments you can make for posterity, unless you neglect them in pursuit of short range goals. Is your family being fed right so they'll be able to live long, healthy, and productive lives? Do you even know what they should be eating? How much have you read about that?

Sure, amateur radio is fun. But so are computer games, playing chess, going to the movies and bowling. There are an almost infinite number of ways to have fun that do little or nothing to help you or your family to grow. I've used amateur radio as a way of learning as well as entertainment. It got me to go to a tech college, then into the Navy as an electronic technician, where the school was superb. But i didn't get on the air and vegetate. I was quickly experimenting with VHFs. My first ham contact was with a 2-1/2m walkie-talkie I built from an article in *Radio*. Then I discovered RTTY and helped put an RTTY repeater on top of a NYC skyscraper in 1949. The next thing you know I was doing an RTTY newsletter, then a magazine on the subject. When NBFM was invented I was one of the first using it in 1946. And so it went with SSB in 1954, SSTV in 1968, my own repeater in 1969, and so on. I've never vegetated in ham radio.

Give your life some thought and try to take a long range look at it. What can you accomplish with the time you have left? Is being just another cog in the wheel enough? Do you really want to spend your life on petty quarrels with idiots? If so, why not get into politics?

In my editorials I've been trying to get you to open your horizons. To read, learn, understand the world, and help me move it ahead. I feel I've been successful in pursuing my goals. I've helped just a little to bring the world cellular telephones, computers, and better music. Now it's cold fusion, which will be the greatest gift I'll ever be able to give the world by far. Sure, all of these things would have happened without me, I'm sure. But my minuscule pressure has helped. No, I haven't gotten many honors. But I haven't hungered for 'em. No "Ham of the Year." Etc. But I have helped thousands of my readers to have better lives, and I don't think I've caused anybody to have poorer lives for having read my magazines or even for having worked for me.

With the millennium coming in four years, why not take a few minutes to re-focus your life. Think about your wife. Your kids. What can you do that will make life better for them? How about your business or the people you work for? What can you do or study that will help them and you? What new skills can you build? Are you working at a job that is more fun than work? So why not? Is it worth your time and effort to learn about nutrition so you and your family can live to 150 and be healthy and productive every day of your lives? Are you using amateur radio as a way to have fun while you are learning? Or are you a vegetating curmudgeon? Is working a new country more important than helping your children to grow? Is that 75m net more important than taking your wife out to dinner and a movie? Or maybe planning a surprise trip somewhere for a weekend?

Are you stuck up on some 2m repeater for life? I feel so sorry for the no-coders who are not using the key to fun and education they have in their hand. No, not the CW key, it's the key to packet, satellites, slow scan, and so on. I feel sorry for the thousands of hams living out their remaining days on 75m nets, or fighting pileups and queuing up for DX lists. Amateur radio should be a key to fun and education, not an end in itself. Lift your eyes from this page and stare out the window. It's a big world out there and it's in desperate need of help. Help *you* could provide.

Our school system is awful because you let it get that way. Ditto our medical industry. And crime, drugs, and so on. When people work for me one of the first lessons is to erase the whole concept of "that's not my job." The bad language on our bands *is* your job. The Techs stuck up on 2m because no one has pushed them to upgrade *is* your job.

Small business is the real power of America, not the *Fortune* 500 giant business cartels you've meekly let get control. With the help of Limbaugh we've started flushing the crap out of Congress, but if you re-elect any incumbents you're partly responsible for the proliferation of drugs, crime, the bulging bureaucracy, and so on. Never Re-elect Anyone (NRA) is my bumper-sticker slogan. Get those greedy old Byrds out of congress.

Continued on page 25

Number 6 on your Feedback card

LETTERS

From the Ham Shack

Klaus Wolter N8NXF. Wayne, what's this noise I read in your editorial about a motor/generator perpetual motion machine? I doubt there is any magic involved. I have not looked at the patent but will poke a guess. You mentioned that this motor/generator claims an input power of 19.55 watts to run as a motor and that the generator puts out 62.16 watts. I'm sure it can, but I'll bet you it can't do it at the same time! I bet the electric vehicle (scooter) you rode was powered by a battery whenever it required energy to accelerate, chug up a hill, or maintain speed. When it is time to slow down or come to a stop, the motor controller dumped that energy by running the motor as a generator and recharging the battery. This is nothing new in EV circles and is commonly used. It's called regenerative braking. A net excess of energy however cannot be produced by such a system. The high density magnet Takahashi developed, among other things, can make for smaller monor/generators. A problem with regenerative systems is that it is possible to demagnetize the magnets in the motor if one tries to generate too much power while running it as a generator. These magnets seem to be more immune to this when I consider the generator output/motor input ratio. I enjoy your editorials. Keep it up! *(Klaus, I'm suspicious of any claimed over-unity devices, so I'll be watching to see where the catch is. With the cold fusion effect now seemingly coming from the transmutation of elements within the metal lattice rather than zero-point energy or any other over-unity systems, it seems on firmer ground. Wayne)*

Marion Kitchens K4GOK. I do enjoy your editorials. And I agree with about 95% of your ideas, thoughts, comments. As a professional working for your government, I use many of the same techniques you do when trying to get people to use their brains! It is sometimes a real challenge, sad to say. Anyway, don't let up -keep on keeping on. There was a delightful change in the February issue of the magazine, specifically on the "Table of Contents" page. No, I did *Not* read that part about "The merest glance.......... Not me — no way will I enter a contract like that! Ha, Ha, Ha! Seriously, it is good to see the perky, humor shown therein. Maybe that means a positive, energetic bunch around the editors' desks. I hope that is the case.

Give the article by W6IOJ a "G" rating. It brings back some of the things I think are important to, but missing from, our hobby. Namely, showing people how to achieve good, positive results by hands-on experience with easy, simple techniques. In my humble opinion, that is a great article. See if you can find more like it for future issues. I for one, will read 'em all. *(Thanks! And congratulations on only being wrong 5% of the time. Wayne)*

John Clark KA2ZPM. Many hams with cataracts or whatnot will appreciate your almost total conversion to Roman type and the leading. Good job on the January issue. Wish you many ads in '96. *(Tests have always shown that serif-style type (such as Times-Roman) are much easier to read than sans-serif type. And that increases the comprehension and retention of the material. But artists, who are unconcerned with type readability, prefer the more beautiful sans-serif type (such as Helvetica). Anyway, glad you approve. Now, if we can only get our photo scans to look better! One more thing. I'll have to write about this, but according to Dr. Wallach, who is a Nobel nominee, cataracts are purely a mineral deficiency disease. If you get the minerals your body needs your eyes will do just fine. Wayne)*

Arthur Harris KC6WZJ. It appears to me that you are overlooking an excellent business opportunity. As you close down *Radio Fun* you should start a new magazine called *No Code*. In fact you should close down 73 also, since the numbers indicate that 73 is aimed at a minority audience. The new magazine would encourage the no-code majority to form their own radio clubs and pursue their own agenda. Of course, the first two things on that agenda would be to petition the FCC to eliminate the code requirement in amateur licenses and the other would be to recognize that the keypounders are **the enemy**. Their interests are not our interests. Lest the keypounders get upset, they should remember it is their mandate that puts the majority of amateurs in the back of the bus. Us po' no-codes just gettin' tired of the small back of the bus with all you minority folks up in the big front of the bus. Maybe its time for a little affirmative action.

You get many club newsletters. How many conduct code classes? I have visited a few and none gave code classes. Theory but no-code! If code was God's gift to mankind, as asserted by the keypounders, it seems to me that they would be falling all over themselves to give classes and enlighten the po' unwashed no-coders.

Sitting here in the back of the bus, gazing forward to the keypounders and especially towards those Big Daddy 20 wpm types, I'm struck with an observation. How come these people will talk on HF with foreign no-code amateurs, but will not do the same for American no-code amateurs? Talk about bogus! I guess honest keypounder is an oxymoron after all. The majority of material in 73 deals with areas which are forbidden to me as a no-code amateur, thus I wouldn't dare comment, lest it offend my betters. I'll give "Kill Your Interference" at least 10 G's. *(Art, I have so many economic opportunities I don't know which way to turn. I could have turned Radio Fun into a no-code rag and made big bucks. I think CQ is doing that. But then their editor is still a Tech. after all these years. But shame on you for fanning the flames of religious intolerance, the code being a religious matter, not one of reason. While I think the code test is a stupid hangover from antiquity, I have no sympathy with anyone who is too lazy to learn it. If they use my method almost anyone can learn to copy 13 or 20 wpm in a few days. Or you can use the ARRL and other systems and take a year or so of frustration and sweat. I went that route, so I know how awful it is. The few clubs that have code classes are teaching to old slow system, so stop fussing about that. You don't need a club, all you need is a couple of my code tapes and the gumption to actually use them for a few hours. Tens of thousands of hams have used my method and zipped right through, so don't come whining and sniveling to me about how the code is an obstacle ... Wayne)*

Bed Hodgins, Riverton NJ. First some background information about myself. I'm sixteen years old and I'm a sophomore in high school. I don't have a ticket yet, but I sure would like one.

Just a few thoughts before I say what I'm really writing for. I don't have a subscription to any ham radio magazines. About the only time I get one is when I have a few extra dollars in my pocket. I invariably get 73 because I enjoy reading your columns. So much of what you say needs to be said more often. Especially in the December's issue. Your view on the minimum wage is right on. You are the only person that I know of who's saying those things. Hopefully your words on that subject will show a few people "the light."

What I really wanted to write about concerns the issue of recruiting new hams. It seems that the hobby is losing more hams than it is replacing. This is something that you are concerned about. I've been very interested in ham radio for five years now. Part of the reason I haven't gotten my ticket yet is that I haven't found a VE to give me the test. But that is only part of the reason. At first I was scared of the code. I'd spent time trying to learn it, and never succeeded. When the FCC announced the no-code Technician license, I decided to go that route until I could conquer the code. The other reason I've not taken the step is my lack of a mentor. You see, unlike all these young kids and who have hams in their family going all the way back to Tesla, my father is not interested in ham radio. If I do happen to get my license and maybe some day a radio, he'd be glad for me, but he's not going to go too far out of his way for me.

One of the remedies to my first problem (the code) is your solution—"To he— with the code." Another of the remedies is for older, more experienced hams to take a greater interest in recruiting new hams. Most newspapers have a section that lists community events. It would take all of ten minutes to call

Continued on page 15

QRX . . .

FleaSpeak 101

With Dayton and a host of smaller hamfests coming up this spring we thought it might be a good idea to brush up your vocabulary so that you understand what those well-meaning hams on the other side of the flea market table are saying. Here is a translation guide that we pulled off a USENET amateur radio news group.

"This rig puts out a BIG signal!" (The rig flat-tops and distorts so badly, your signal will be at least 50 kHz wide!)

"This rig will bring back the feelings and atmosphere of vintage ham gear." (The bypass capacitors to the AC line put enough voltage on the chassis to give you a shock in the lips through the microphone, and it smokes so much when you turn it on that you'll probably start coughing and wheezing.)

"The transmitter is outstanding." (It doesn't receive.)

"I just aligned it." (All the slugs on the transformers are now snugged down tight.)

"This is the rig of my dreams. I really wanted one of these as a kid, but now (snuffle) I've got to let it go." (As I've gotten older, I've learned what a hunka junk it is.)

"It worked last time I used it." (And if it still worked I'd still be using it.)

"Real popular rig in its day." (Yeah, there were whole HF nets on the repair and maintenance problems.)

"I'll help you carry it to the car." (I'll do anything to unload this boat anchor.)

TNX to Dave W9GR and all the others that contributed to this post.

Tampa Museum Pays Off!

Robert and Janice Miller and their two sons, Frank and James, visited the Museum of Science and Industry in Tampa FL about two years ago. Everett Hale KA4IZQ showed them what ham radio was all about at KE4ZRS, the museum amateur radio station. The Millers, from La Belle FL, were so impressed that they decided to become ham radio operators. Within two years Robert obtained his Advanced Class license, his 16-year old son Frank got his Extra Class ticket (AD4RD), his 14-year old son James got his Advanced Class ticket (KE4PQH), and his wife Janice got her no-code Tech ticket (KD4ZIX). Have any other museum stations won us converts? No reports of such, so presumably not. TNX Clark Evans WA4DLL for the news.

Another Milestone

Larry N8GZW and JoAnn Brauneller of Ohio celebrated their 35th wedding anniversary October 22, 1995. Adding to the festivities was Keith Berning KCØWL, who presented his parents-in-law with a commemorative copy of *73*'s 35th Anniversary issue. Congratulations from all of us to this ham family! (Photo by Keith Berning KCØWL.)

What a place to blow a fuse

German cosmonaut Thomas Reiter DF4TR/DPØMIR, aboard the Mir orbital complex, reports that a power supply used for some of the spacecraft's ham radio equipment failed on New Year's Eve. The remaining older power supply is only capable of powering the old Icom 2-meter transceiver and one 1200-baud TNC. The digital voice module also has failed, so there will be no more automatic voice recordings in the near future. Reiter reports all four fuses in the two connected transceivers have blown and only two spare fuses remain. Last month, Reiter used the digital voice recorder, built by Thomas Kieselbach DL2MDE to broadcast holiday messages. The primary transmitting frequency is 145.800 MHz. Recently, the cosmonauts on Mir unpacked new amateur radio equipment delivered by rocket, including a 70-cm FM transceiver and 9600-baud packet gear. Reiter was philosophical. "Well, at least we can be reached and still can talk with the world," he said in a message to Dave Larsen N6JLH.

TNX W1AW bulletin ARLS001

How's Your FIST?

Just got your Novice or Tech-Plus and want to give CW a try? (After all, you did put all those hours into code tapes and they say the best way to build up speed for that General is on the air.) Check out FISTS CW Club. Our Tech Editor N1VXW after a very long CW QSO with Ken Coughlin KF8RG was sent a QSL and an application to FISTS. The CW club is the membership organization of the International Morse Preservation Society, a club dedicated to keeping CW alive, well and fun on the amateur bands. While Morse may not be everyone's cup of tea, FISTS is dedicated to helping Morse be a pleasurable experience for those inclined to try it.

FIST organizes high and low speed nets on a weekly schedule, provides QSL Bureau services and there's even a number you can call to "Dial-A-Sked" so you can make that first CW contact less nerve-racking. The organization was founded in England in 1987 and has a North American branch. If you're a newbie to CW or have been pounding brass for longer than you can remember it just might behoove you to get in touch with Nancy WZ8C, the North American Representative of FISTS. She can be reached at: PO Box 47, Hadley MI 48440-0047, (e-mail 73631.3654@compuserve.com).

440 Super J-Pole Antenna

Here's a great club project!

Marty Gammel KAØNAN
1703 Hewitt Avenue West
St. Paul MN 55104-1128

Why pay commercial prices for a UHF antenna you can build at a fraction of the cost? Here's a great antenna you can build for less than $7 (at current prices). Even better, once you have all the materials in hand, it should slip together in less than an hour. Then you can brag that you "made it yourself!"

"They have almost 6 dB of omnidirectional gain, and don't have that crummy lobe shooting up toward passing aircraft that a well-known commercial antenna suffers."

I love J-pole antennas for the VHF and UHF bands. They have almost 6 dB of omnidirectional gain, and don't have that crummy lobe shooting up toward passing aircraft that a well-known commercial antenna suffers. They consist of a vertical quarter-wave antenna, with a half-wave mounted above it to provide gain by concentrating the radiation in a narrow vertical lobe.

Building the antenna

First, clean the areas of the tubing that will be soldered. Use a scrubbing pad or fine emery paper to get good, long lasting solder joints, since clean mating surfaces are very important. Clean the 3/16" tubing at this time, too. Clean *all* the copper with a solvent such as lacquer thinner or acetone and a rag, and do it in a *well ventilated* area. You don't want to inhale any of that stuff!

Lay all the half-inch copper sections out and apply flux to each piece to be soldered. I use a paste flux and apply it to the tubing, giving a twist as I assemble each piece to the next one to spread the flux around the whole joint. It helps to set a weight across the 19" and 6" pieces to keep them parallel during the soldering process. Measure the distance between these at the top and bottom of the 6" section to make sure that they are equally spaced. This is the tuning section of the antenna. Be generous with the flux; it helps clean the surfaces, as well as helping solder flow with less overheating and discoloring of the copper tubing. Any excess flux can be cleaned up using a rag and solvent after the soldering is complete.

Install the 12" wood dowel insulator between the upper and lower vertical sections. Form the 1-1/8" by 2-1/4" piece of sheet metal to make a heat shield to avoid burning the dowel. Next, drill a 3/16" hole about 1/8" in from the upper end of the lower section of the half-inch copper tubing and dowel, and do the same with one end of the upper vertical section of the copper tubing and the dowel. Bend the 3/16" tubing to form a very tall "U" shape and insert the ends into the holes you have just drilled.

You can start soldering at either the elbow or the threaded fitting, heating the copper ahead of the torch by allowing the angle of the flame to preheat the next joint. Solder all the lower joints and the "U" matching section first. Allow these to cool before you solder on the end caps. After the copper has completely cooled, clean the flux off all the solder joints using solvent and a rag or paper towel. Then, with a clean rag and solvent, completely clean the entire antenna. Once the solvent has evaporated, spray at least two coats of an exterior clear finish on all the surfaces of the antenna to keep it looking new.

Apply caulking or silicone to the dowel insulator and wrap this area with electrician's tape. It won't hurt to apply a coat of the exterior finish to further seal this area.

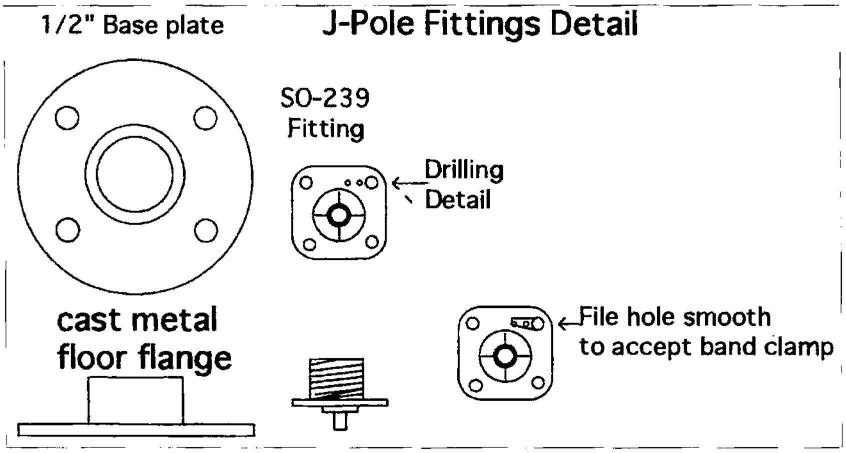

Fig. 1. Construction details.

Now we're ready to work on the coax feeder. The two hose clamps will be clamped to the pipes about 2-1/2" above the bottom crossbar. One will be screwed to the SO-239 flange and the other to the center connection, via the short piece of #16 wire. You'll probably have to drill a special hole to screw the SO-239 flange to the hose clamp. Now strip about 3/8" of the insulation from one end of the stranded #16 wire. Solder one end to the center hole of the SO-239 and the other to the clamp on the long vertical section of the antenna.

Tuning the antenna

Clamp the base plate to a stepladder or a railing away from close objects. Be sure your SWR bridge is capable of measuring at 450 MHz. Using low power, start by measuring SWR at the top, middle, and bottom of the band. The 2-1/2" feed point height above the crossbar should be very close. Move the feed point by sliding both clamps only 1/16" up or down. Try to find your best SWR on the repeater input part of the band, if that is where you plan to use the antenna. Using this design you should have an SWR below 1.5 over the band.

Parts List

Type M 1/2" copper tubing, cut to the following lengths:
19" (1)
12" (1)
6" (1)
1-3/4" (2)
13" of 3/16" copper tubing
1 1/2" copper elbow fitting
1 1/2" copper "T" fitting
2 1/2" copper end caps
1 1/2" copper threaded fitting
12" length of 1/2" birch dowel (for insulation)
1 SO-239 fitting
1 short piece of #16 stranded wire
2 5/16" x 7/8" stainless steel hose clamps
1 1/2" cast metal floor flange
Spray-on exterior clear finish
Plumber's tubing cutter
Electric drill and bits, 3/32" and 3/16"
Propane torch, solder and paste flux
Screwdriver
Electrical tape
Solvent and scrubbing pad (or steel wool or emery paper)
Caulking or silicone
1-1/8" x 2-1/4" sheet metal soldering shield
Drill press, small file (both optional)

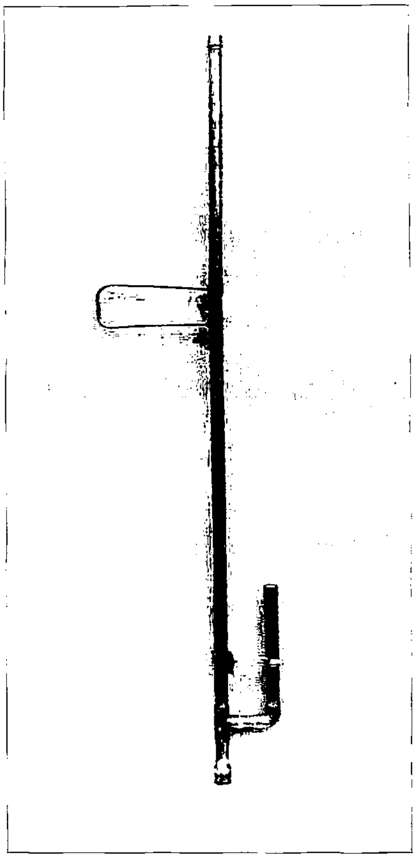

***Photo A.** The completed 440 Super J-pole.*

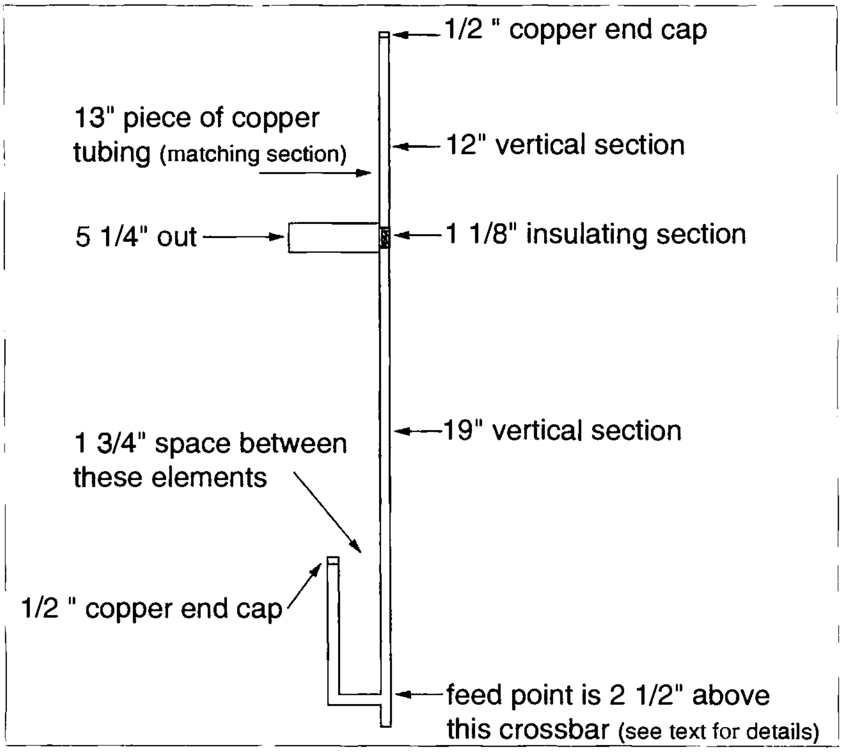

***Fig. 2.** J-pole fittings detail.*

Tighten the feed point clamps, apply a coat of silicone to the back of the SO-239, and then spray a coat of exterior finish on the tuned feed point to seal out the weather. Tape the feed point connection to the coax, and also tape the feedline to your mast every two or three feet to make a neat, long-lasting, trouble-free installation.

Note

If you want even more gain you can add two more vertical half-wave sections, along with a horizontal matching section for each of them, using more birch dowel insulating sections. Place each matching section 120° from the section below it (otherwise you may distort the omnidirectional radiation pattern). This gave me three vertical half-wave sections above the typical J-pole design of a vertical half wave driven by the quarter-wave tuning section below it. Field strength tests showed that there was a 50% increase by adding the two vertical sections.

If you have any questions just send a #10 SASE to my home address above.

The Hentenna

An easy construction project and a chance to experiment.

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Don't you just hate it when antenna articles tell you how great the antenna is and then leave out some important piece of information? This happened with the hentenna. I've only seen two articles on it, one in QST (Feb. '82) and the other in Antenna-X (May '89). They both described its history and wonderful performance, but gave only the vaguest indication where the feed point should be. I had clipped both articles and filed them away, but it kept nagging at me. Well, I had to find out if it's as good as reported and where the feed should be connected.

The basic design of the hentenna is a simple wire loop. It's half a wave high and a sixth of a wave wide, making a tall, skinny-looking quad (total wire loop length is 1-1/3 waves, Fig.1), except it's not fed at the bottom or side, but from the inside. Exactly where on the inside? Near the bottom, but not too near.

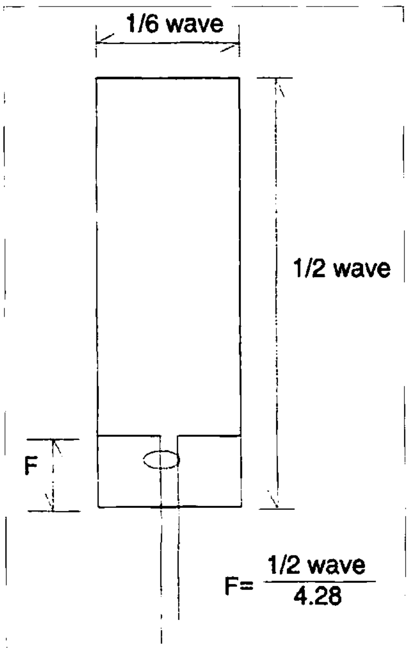


Fig. 1. The basic design of the hentenna is a simple wire loop. It's half a wave high and a sixth of a wave wide.

"Construction is so easy there's no excuse for not having a hentenna around."

Both articles made reference to a skeleton slot antenna to describe how this one works, but to me, it looked like a misshapen quad with a really fat tuning stub. The feed was placed one sixth of a wave up from the bottom, making the top loop, starting from the feed point, one wave long and the bottom loop two-thirds of a wave in length.

To start with I made a UHF model for TV. Using 14-gauge solid copper wire was easy; no supports were needed except the upright, a length of scrap wood (1" x 1"). My choice for a UHF TV station was one of the weaker ones. I didn't want to overpower the antenna and get poor readings. If it pulled in a weak station the lobes should be more pronounced (and they were). This UHF design performed better than I had hoped. Picture quality was equal to a flat four-bay commercial UHF antenna, but the hentenna had narrow lobes (bi-directional). I couldn't twist it much left or right before losing the signal. Tilting it forward or backward also lost the signal. It seemed directional with some gain, but without a boom. Could it work this well on 10 meters? I'd have a winner on my hands if it did.

Constructing the 10 meter hentenna was a little different. All three horizontal members had to be supported to hold up the 14-gauge wire. For the top crossbar I used a 1" x 2" five and a half feet long. For the other two only 1" x 1"s were used.

After soldering the loop together and attaching the top and bottom crosspieces, I measured out 67 1/2" up from the bottom to connect the feed. This starting point turned out to be too high. Measuring with the least possible power output the SWR was 3:1. Lowering the feed point one inch at a time was tedious. I went to three-inch steps, then two-inch steps, and finally one-inch steps. To make it a 1.1:1 SWR, I lowered the feed point 21 inches from where I'd started. I'd been way off. The final SWR curve was so flat I had to check it twice. At 28.0 MHz it had an SWR of 1.2:1, at 29.0 MHz it was 1.5:1, with the trough at 28.4 MHz and a 1:1 SWR, perfect for the Novice band.

Going back to the UHF test model and lowering the feed point to the right spot, I found the performance the same. If the UHF model worked the same, could it be hoped that the 10 meter prototype would be a wire wonder?

Wouldn't you know it? The band was dead. Sure, there are openings even during sunspot lows, but I couldn't find many after building the antenna. I did make some contacts; that says something for this antenna (gotta study those propagation predictions a little more closely). Sorry, not enough on-the-air reports for this one to make any solid conclusions. In general, this antenna is broadbanded with a low SWR. It's directive enough to eliminate some QRM if turned by some means.

LETTERS
Continued from page 6

the newspaper and tell them the date and place of the next ham club meeting. Also, almost every high school has clubs. Find a teacher to sponsor a ham radio club, or get permission to talk to the computer or A/V club at the school. Be willing to spend time with prospective hams, and talk with their parents about the hobby. In recruiting new hams try to shake off the myths of ham radio such as the code obstacle and imagined expense. Point out the high technology of the hobby such as packet radio, SSTV, and circuit building. If just a few hams in every city decided to recruit one new ham in 1996, amateur radio would get the needed hobbyists and you would have a better chance of saving your precious frequencies.

One other suggestion. Public and high school libraries suffer from a dearth of current books on technology, electronics, ham radio, etc. While looking for info on hamming, if I could find books, they'd be twenty to thirty years old. It's hard for me to believe the ARRL wouldn't have some sort of deal where a club could buy certain books for local libraries. *(Ben, when I got interested in amateur radio I first turned to my school library, where I found* QST *and* Radio. *In looking over the 73 subscription records I see very few school libraries subscribing. You or your club could help attract the youngsters we so desperately need by providing gift subscriptions to 73 for your local school and town libraries. Wayne)*

Sacrificing another wire for another band, I grabbed the handie-talkie and headed for the calculator; I'd make a 2 meter version with the ratios from the 10 meter hentenna.

I was sick of converting decimals to English measurements, so metric was the rule of the day (and it was a lot easier). Rewriting the little program to come out in meters was easy; it was just replacing one formula. After doing the calculations and construction in metric it'll be tough to go back to English measurements. I wonder if the local hardware super-store has a 20 meter tape measure? (Ha!)

Construction of the 2 meter hentenna is similar to the UHF model, however, the 2 meter model needed a top crosspiece to support the weight of the wire. Staples held the crosspiece to the upright and the coax to the mast. I don't have a VHF SWR meter, but Hank Koch NFØH does and that weekend he was working on the local repeater. Hank was happy to help out and we charted a few SWR points.

Setting the handie-talkie to 146.000 MHz we read the SWR as 1.3:1. "Hey, you could use it just like that." Hank said. "Let's try down the band." Next at 145.000 MHz it was 1.2:1 and then 1.4:1 at 147.000 MHz. Is that broadbanded enough for you?

I thanked Hank for his help and went home to play twist and chart. The UHF-TV model had such sharp lobes I thought I'd chart the radiation pattern of the 2 meter hentenna. By finding a signal source and then twisting the antenna until the signal strength meter read down three dB (the half power point, Fig. 2) I could chart (roughly) the radiation pattern. The strongest signals were received when the hentenna was held straight up and the face of the antenna held at a 90° angle from the signal source. Tilting the hentenna forward, and then back, gave an estimate of the forward radiation angle. It came out uneven: 35° forward or 40° back brought the signal strength meter to the half power point. Twisting right and left brought more off center readings, 80° one way and 40° the other, the difference being which side the shield is connected to. The largest null is on the side the shield is connected to, 100° from half power point to half power point. On the center conductor side, the null is 20° wide. All this would even out, I guess, with the use of a balun or balanced feed as described in both reference articles (they both used a bazooka feed). I didn't use any matching feed system in my experiments so I could find the 50-ohm feed point without added hardware, and it makes construction easy.

Performance

Performance on the air is surprising. Most radiation is horizontal when held upright, with some vertical polarization, a combination that makes for a good general-purpose antenna. Some gain is evident, as much as a three element yagi maybe. Repeater reception is better when the hentenna is tipped sideways, but not too much.

Tipping the hentenna sideways gave me an idea. If I made a 15 meter hentenna it would fit (tipped horizontally) in the attic. Well, I made it right there in the attic and the SWR was way too high. Thinking that it was the stray capacitance from roofing nails and assorted metal valleys I moved the antenna outside and hung it from the eaves. It hung down to within two feet of the ground and two feet away from the house. Same lousy SWR. What with yard work and winter coming this one would have to wait for another season.

"The hentenna is a great VHF project to add a little gain for portable operations or a simple base antenna for simplex or repeater work as well as the 10 meter Novice band."

The hentenna is a great VHF project to add a little gain for portable operations or a simple base antenna for simplex or repeater work as well as the 10 meter Novice band. Construction is so easy there's no excuse for not having one around.

These are all wire, temporary antennas for experimenting. For outdoor, permanent antennas you'll have to use more durable materials. I had to leave something for you to figure out for yourself, didn't I?

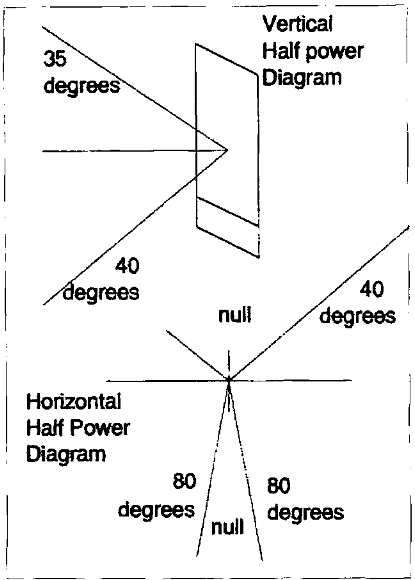


Fig. 2. Hentenna radiation pattern.

Hentenna measurements

Band	1/2 wave	1/6 wave	Feed point
10m	16' 6"	5' 6"	3' 10-1/4"
6m	8' 10"	2' 11-1/4"	2' 1/16 "
2m	3' 3"	1' 1"	9' 1/8"

Table 1. Hentenna measurements for 2, 6 and 10 meters.

73 Review

Number 17 on your Feedback card

The TriField Meter

Do you trust your *microwave oven?*

Michael Jay Geier KB1UM
c/o *73* Magazine
70 Route 202 North
Peterborough NH 03458

This has to be one of the most unusual products I've ever reviewed. The TriField meter is intended to measure magnetic, electric and radio (electromagnetic) fields, in order to help you avoid unnecessary exposure to these controversial emissions. The unit employs separate sensors for magnetic and electric fields, and it comes with a treatise that discusses the probable effects of the various kinds of fields and how the human body responds to them.

The meter itself has three calibrated scales. One reads magnetic fields in the 0 to 100 milligauss range, and also reads electric fields when the unit is set to detect them. The second scale reads much smaller magnetic fields, in the 0 to 3 milligauss range, while the last one reads radio and microwave emissions in the range of 0.1 to 1 milliwatt per square centimeter.

The magnetic and electric field settings are frequency-weighted from 30 to 500 Hz and are calibrated at 60 Hz. The readings increase with frequency. So, a 2-milligauss field at 60 Hz will read "2" on the meter, but a 2-milligauss field at 120 Hz will read "4." This is intentional, because, according to the instructions, the currents induced in the body are proportional to field strength multiplied by frequency. Essentially, that makes the meter an indicator of induced body currents, rather than a field strength measurement device.

The choice of 60 Hz as the reference point was made, of course, because it's our powerline frequency. The unit's sensitivity increases linearly with frequency until about 500 Hz, and then it stays roughly level (± 20%) up to 1 kHz. After that, it gradually reduces to zero at about 100 kHz, although there is some residual sensitivity up to about 100 MHz. Overall accuracy is specified at ± 20% for magnetic fields, and ± 30% for electric fields, RMS at 60 Hz.

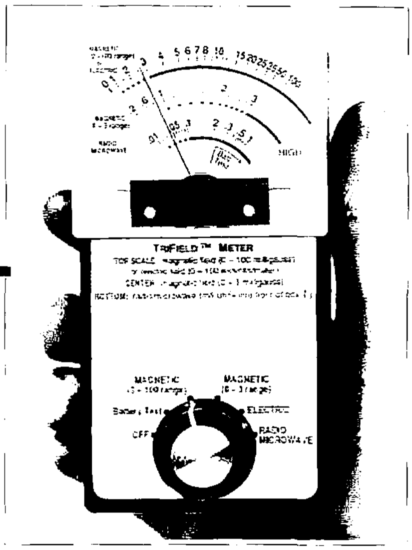
Using it

The meter is housed in a plain plastic box, and is powered by a 9-volt battery, which is supposed to last about 30 hours. Changing the battery requires unscrewing the back of the box.

A rotary knob lets you select the five ranges and a battery test range, which is a handy feature. Although the internal positions of the various sensors are described in the instructions, there's no mention of them on the unit itself. The electric field sensor is at the top of the unit, and the three magnetic sensors are on the front, below the meter. Operation is as simple as selecting the kind of field you want to see and moving the meter around near the field's generator.

The results can be surprising. My laptop shows significant magnetic fields around the hard drive and the power supply for the backlight, as I would expect. It also shows noticeable electric fields in front of the display, no doubt from the backlight element itself. No measurable radio fields are detected, probably because they're at too high a frequency for the TriField meter to have much sensitivity to them.

My desktop computer monitor shows strong magnetic fields near the face of the CRT, but they fade away rapidly. While electromagnetic near fields become



weaker in accordance with the inverse square law (the strength of the field is inversely proportional to the square of the distance), magnetic near fields follow the inverse cube law (they're inversely proportional to the cube of the distance), making them become much weaker for a given distance.

Using the radio setting around the seal of my microwave oven door shows a very low leakage rate; I guess my oven's in good condition. It's reassuring to know I'm not getting cooked along with my dinner!

"It's reassuring to know I'm not getting cooked along with my dinner!"

Is it for you?

This device isn't meant as an antenna field strength meter! Its non-linear interpretation is clearly geared toward telling you what the received fields might be doing to your body, based on induced currents. If you don't know the frequency of the received fields, there's no way to determine whether the actual field strength is, say, 9 milligauss at 60 Hz or 2 milligauss at 250 Hz. So, for normal, home use, the meter is best used as a relative-strength guide to sources of significant emissions, rather than as a method of obtaining actual field strength measurements.

The included paper is well-written and fairly detailed, but it is important to note that no conclusive evidence of harmful effects of low-level fields exists. In fact, the literature goes so far as to state "some readings in the high (red) zone may ultimately prove not to pose a health risk." In

Continued on page 19

The Big Loopy Skywire

Cheap and simple, with a bodacious signal.

Dean Frazier NH6XK
94-567 Kuaie St.
Miliiani Town HI 96789

When the Loop Skywire is mentioned, most amateurs immediately think of acres of property with no antenna height restrictions. But such conclusions are misconceptions when it comes to putting up a Big Loopy, and generating the "Big Signal." For the Big Loopy, a full-wave loop in the horizontal plane, the area needed, and the best height, are all pretty much dictated by the frequency of the *lowest* amateur band on which operation is desired.

Loop size depends on frequency

For 80 meters, you need 1005/3.75 MHz = 268 feet of wire which would be 268/4 = 67 feet on a side if the antenna is square; but a Big Loopy on 10 meters would require 1005/28.4 MHz = 35.4 feet of wire. That is, 8.85 feet on a square side, and it might as well be hung vertically as a true quad loop. However, there is a point where a vertical loop becomes impractically large to erect: a vertical loop for 40 meters would be 1005/7.15/4 = 35 feet per side, out of the question for most amateurs. But since the radiation from a full-wave loop is not all perpendicular to the plane of the loop, a large loop strung horizontally does work.

My experience, and that of others who have put up a full-wave loop for 80 meters, is that the loop radiation goes up at high angles, which is great for propagation out to about 1,100 miles and multiples of this distance. Upon reflections, the signal comes down "hard." The very first night I tried the Big Loopy, I managed to communicate with the radio operator on an oil tanker in the Caribbean (5,500 miles distant from my QTH in Hawaii) on 80 meters. Although I was running 400 watts I was told that my signal was obnoxiously loud.

The Big Loopy

My Big Loopy measures 285 feet around, and it is not at all round or square, but as seen from above, has the outline of a necktie (see Fig. 1). Although the *Handbooks* recommend 272 feet for the loop on 80–10 meters, I chose this length of wire based on the following calculations:

1005/285 = 3.526 MHz

and multiples of this frequency are

7.053, 10.579, 14.105, 17.632, 21.158, 24.684, and 28.211 MHz

which multiples more or less match my preferred regions of operation on the HF bands. Had a 272-foot length been chosen, all frequencies for lowest SWR given above (for a length of 285 feet) would be shifted higher by a factor of

285/272 = 1.048

e.g., 7.053 MHz would have been 7.39 MHz, *out of band*. Also, the bands for which 285 feet of wire will not quite be on resonance (for which there would be some reactance), are handled by a simple Inductance/Capacitance (L/C) tuner, or "Matchbox," at the shack.

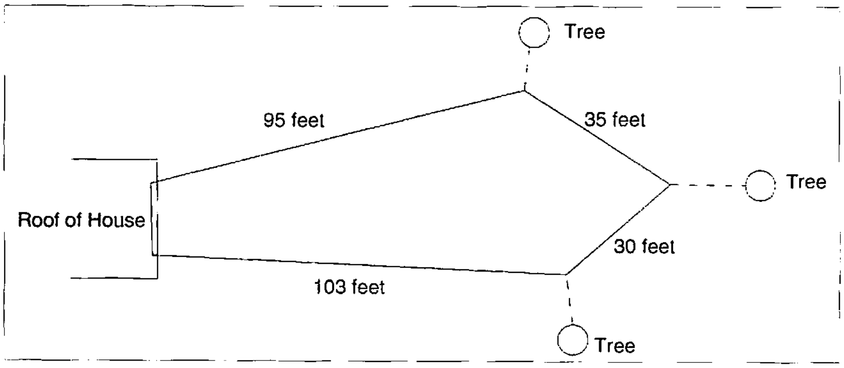


Fig. 1. Layout details of the Big Loopy.

The Big Loopy is fed with 52 ohm coax, as the feed point impedance is between 50 and 100 ohms. Air RF choke baluns are used at both the feed point end and at the shack, to help suppress any RF currents induced on the outer braid of the coax (unbalanced feed line) from the loop radiation. A 1:1 balun at the feed point could be used. And an open ladder-line feed system would probably be best, but up to 700 watts, on all bands through 80 meters, I have not experienced RF.

The feed point is 30 feet up, at the rear end of the house, 70 feet from the shack. The elongated, but not quite folded, dipole outline of the Big Loopy is 40 feet off the ground at its highest point, and the low point is 25 feet high. The long axis orientation is east-west.

As Fig. 1 shows, one end of the wire of the Loopy is connected to the coax center conductor, while the other end returns to the feed point braid. The corners are attached to their respective tie-down points with nylon line. The wire is #12 A.W.G PVC covered solid copper. Note that the east end of Big Loopy is triangular, sloping down, and buried in the forest behind the fence of the property line.

Theoretical considerations suggest that nowhere in the loop should the wire double back on itself; you should try to keep all corners or "turning points" less than or equal to 90° so you don't suffer from signal cancellation. For the strongest signal, you want to make the loop as "open" (covering as much area) as possible. The facts that the loop is neither circular nor square, and is not very high, all result in some increased angle of radiation and reduction in signal strength, but these effects are not as bad as one might guess. The ideal loop would, of course, be circular. With 285 feet taken as the circumference of a circle, this would result in a $285/\pi$ = 90.72 foot diameter circle of 45.35-foot radius, which gives an area of $(45.35)^2 \times \pi$ = 6464 square feet. A square loop in comparison would have sides 285/4 = 71.25 feet, or an area of $(71.25)^2$ = 5077 square feet. The ratio of areas is a measure of radiated signal strength: 5077/6464 = 0.785; dB = 10 log (0.785 = -1 dB. The square loop would be "down" in signal strength from that of a circle's by about 1 dB. As configured, my Big Loopy suffers about 1.5 dB compared to the radiation from a circular loop of the same length wire. However, when you consider that a full-wave loop shows 2 to 3 dB gain over a dipole, at least on 80 meters, I'm still ahead. And on 40 meters, where a full wave 80 meter loop is 2 waves, the Big Loopy has 2x3 = 6 - 1.5 = +4.5 dBd, calculated on the conservative side, or 3x3 = 9 - 1.5 = +7.5 dBd if one is optimistic. Necessarily, doubling the wire, e.g., doubling the number of full waves on the wire at a given frequency, adds about 3 dB of signal strength. On 20 meters, where the Big Loopy is four full waves, then at worst, the gain is 4x3 = 12 - 1.5 = +10.5 dBd. No wonder I am told by hams on the mainland that the Big Loopy produces the "Bodacious Signal."

Furthermore, the Big Loopy is hard to beat when used on 40 and 80 meters, inter-island. I run 10-20 watts, and usually am 59 or "in the red" on the outer islands (Kauai, Maui, Hawaii).

So if you are fortunate enough to have a bit of area, put up a Big Loopy, even if you can only manage 71 feet of wire or so, about 17 to 18 feet on a side, for 20 meters. This will give you 2 waves on 10 meters, and 1-1/2 on 15 meters; the 12 and 17 meter bands being tunable via an ATU or matchbox. Don't worry if your antenna is not exactly square or level or very high. Just put one up and give it a try. You'll put out *some* signal which will go *somewhere*, and you might be pleasantly surprised. And then you can enjoy the fun of tilting a side or an end of Big Loopy to put a lobe where you want. Or you might try loading two sides with about 360 ohms of inductive reactance to create a "Big Baby Loopy" to achieve more gain in a desired direction (see *73 Amateur Radio Today*, November 1992; "Baby Loopy"). 73

The TriField Meter

Continued from page 17

other words, you are free to interpret and worry as you please.

It is important to note that the magnetic field sensors capture only AC fields—you can't use this thing to see how far your speaker magnet's field extends. It is possible to measure steady-state magnetic fields, but it requires a more sophisticated type of measurement device called a magnetometer, which the TriField meter does not contain. As health studies do not currently indict steady-state fields, Alphalab apparently saw no reason to increase the unit's cost to make it possible to measure them.

If you're worried about what your gadgets' fields might be doing to you, the TriField meter will help you find the best placement for your devices and yourself, so that you can minimize your exposure. The price is very reasonable for what it does. It's an interesting and unique product. It's available from Alphalab, Inc., 1280 South Third West, Salt Lake City UT 84101. For additional information contact David at 503-543-6545. 73

Easy to Build 10m Beam

The Sun-spots are coming. The Sun-spots are coming.

Adam J. Felde N6CJU
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This antenna uses four half-wave dipoles whose elements are all cut to the same length. The dipoles are mounted on the boom in piggyback fashion, one above the other. The four dipoles are numbered for identification:

Dipole #1 is at the front of the boom.

Dipole #2 is at the rear.

Dipole #3 is above dipole #1.

Dipole #4 is above dipole #2.

The dipole elements are in a horizontal plane with the earth. This element arrangement allows the use of a quarter-wavelength boom, and makes it possible to use a quarter-wavelength of air space time—the distance between the two sets of dipoles—on an alternate time share basis.

The design frequency is 28.700 MHz. Dipoles #1 and #2 are a set, and dipoles #3 and #4 are a set. Half-inch tubing is used for the dipole elements, which are insulated from each other and the boom. The two sets of dipoles are separated from each other (electrically) by a quarter-wavelength of RG-8U coax delay line. This causes the dipole sets to follow each other by a 90° delay. For example, dipoles #1 and #3 fire in sequence, and dipoles #2 and #4 immediately follow, also in sequence, making one complete cycle of all four dipoles. The close spacing between the elements has no ill effect on performance. Assuming the initiating signal from the transmitter to be a positive-going waveform, dipole #1 will be the first to radiate, followed by #3, whose signal phase has gone negative, along with #2, both of which are 180° for that instant. And, since dipole #3 is at the same place on the boom as dipole #1, dipole #2 will lag dipole #3 by 90° (the distance between dipoles #3 and #2). This will cause a cardioid (heart-shaped) waveform to be radiated from dipoles #1 and #2. In other words, dipoles #1 and #4 radiate a positive-going wave, and dipoles #3 and #2 radiate a negative-going wave. See Fig. 1.

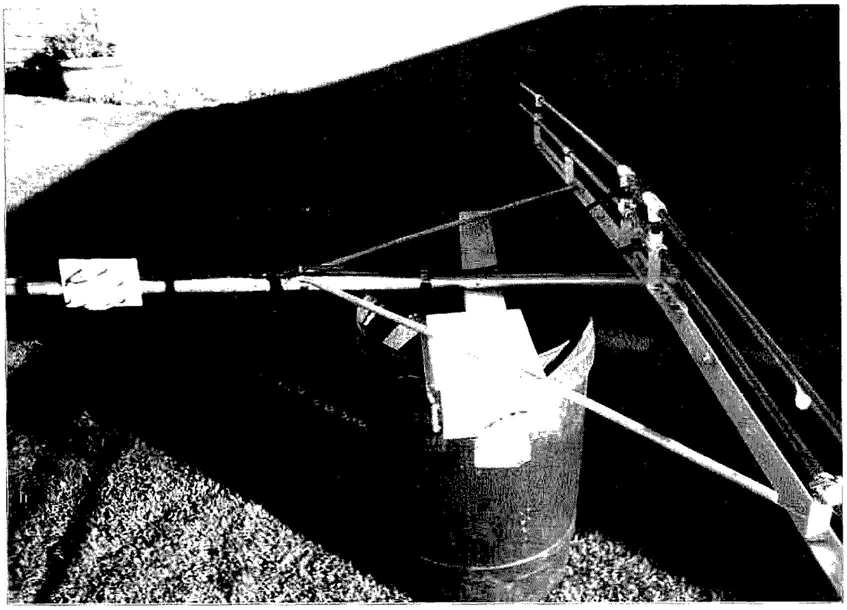

Photo B. *To drill the bolt holes for mounting, flatten 1" of the ends of your 1/2" tubing, creating a support angle stabilizing wishbone.*

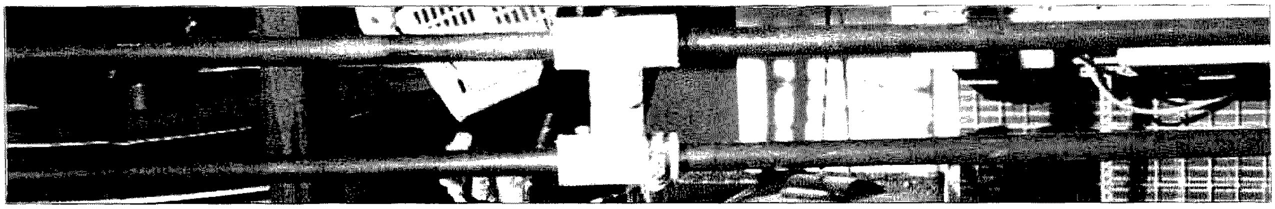

Photo A. *The elements are supported by the PVC plastic three-way "T" of lawn sprinkler pipe to make an "H."*

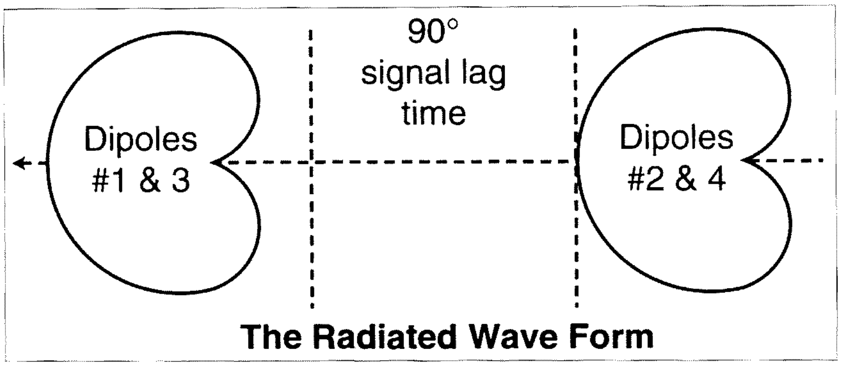

Fig. 1. *The cardioid waveform.*

The SO-239

Drill, in the exact center, a 5/8" hole in a 3/16" thick 3" x 2" piece of Plexiglas™. Drill another hole, capable of receiving a #6 bolt and nut, 1/2" from each end, in the center, to fasten the assembly to the dipole elements. Place an SO-239 chassis adapter/connector plate into the 5/8" hole, and drill four #6 screw holes through the existing holes in the connector body to bolt the SO-239 into the Plexiglas piece. Solder "pigtails" to the connector's center conductor, and to the conductor's outer body, for connection to the dipole elements. Make four of these assemblies, one for each of the dipoles.

Mounting the Dipoles

The dipole elements are mounted on 10-foot aluminum 2" x 2" x 3/16" angles (the elements are insulated from the angles). The boom will be nine feet long. The aluminum dipole support angles will have a "V" stabilizer, reaching from some point on the boom, with the open end of the "V" legs bolted to the aluminum angle spread open to reach at least a two-foot spread on each side of the boom, to make the antenna wiggle-proof (and bird-proof).

The Driven Element

Use a schedule 40 white plastic lawn sprinkler fitting, and a three-way "T" for 1/2" plastic schedule 125. You cut

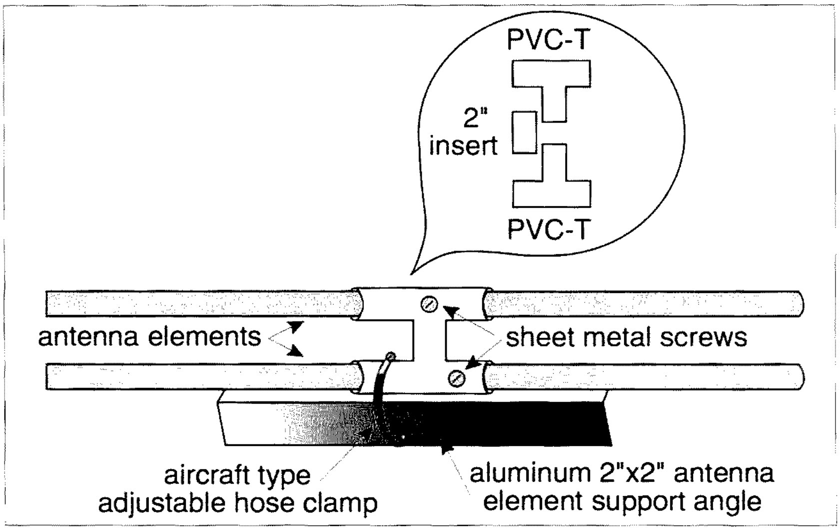

Fig. 2. *A pictorial view of the driven element insulator/supports.*

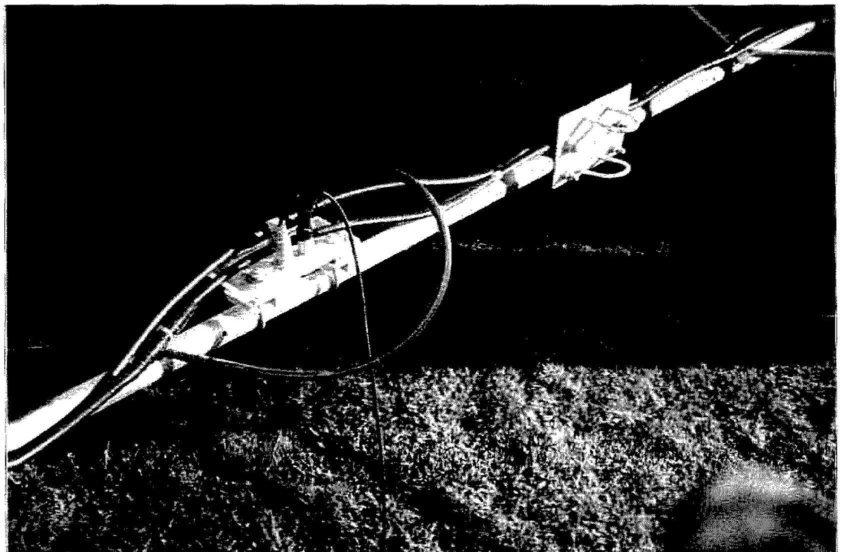

Photo C. *Note the mounting for the delay line and feedline connectors; it's made of 3/16" Plexiglas™ wide enough to receive exhaust pipe-type "U" clamps bolting the unit to the boom.*

a 2" long piece of the schedule 125 pipe to cement into the leg of the "T," then take another "T" and cement the two units together, fashioning an "H." On the boom the "H" will lie sideways. See Fig. 2.

Use an aluminum 2" x 2" x 6' (10-foot is better if you can find it) angle. The insulator/supports you are going to make are clamped to the aluminum angle using #16 adjustable hose clamps. Position the element supports on the aluminum angle so the legs of the "H" are horizontal with the aluminum angle. Clamp them to the aluminum angles shown in Photo D. Slide the dipole elements into the supports and place them so the ends of both halves of the dipole are equidistant from the boom. Drive a sheet metal screw through the plastic support and into the dipole element, being careful not to come in contact with a clamp

and accidentally ground an element. Do this in two places on each dipole element.

The Coax Hookup Assembly

For dipoles #3 and #4, connect one end of a 10' 11" coax into the SO-239 chassis mount on dipole number 4, and connect the other end into the coax "T" (M-358). Connect a 5' 5-1/2" length of coax into the opposite end of the "T," and terminate the coax into the SO-239 chassis mount on dipole #3. Put a PL-258 coupler into the center terminal of the coax "T," and connect another 5' 5-1/2" length of coax to the end of the PL-258 connector. See Fig. 3.

For dipoles #1 and #2, connect one end of the last 10' 11" of coax into the SO-239 chassis mount on dipole #2, and connect the other end into the coax "T" (M-358). Then place a double PL-259 into the coax "T" and connect another coax "T" to it. Then, using a PL-258 connector, connect the center terminal of the second "T" with the

Continued on page 35

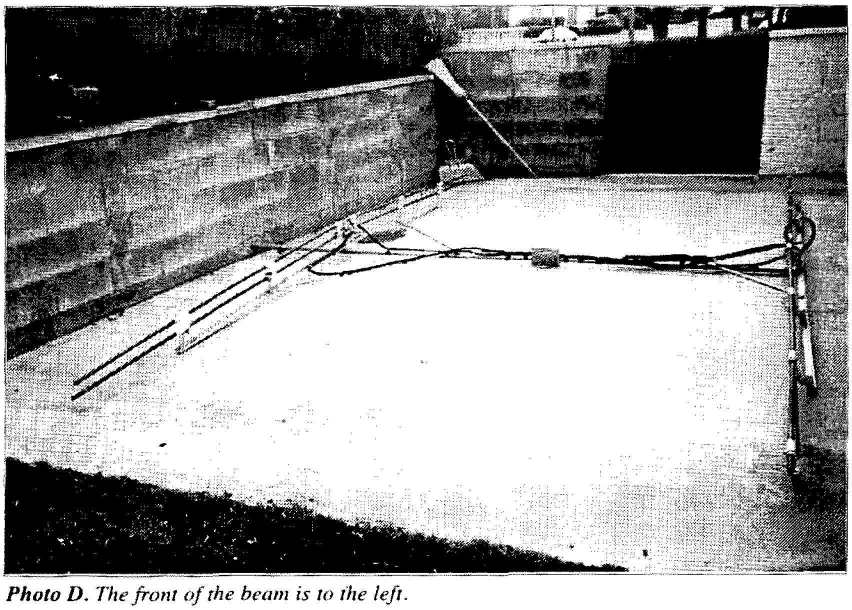

Photo D. The front of the beam is to the left.

Number 24 on your Feedback card

73 Review

CB 148/450 Dual-Band Corner Reflector

Big dual band signals are just around the corner.

Larry Antonuk WB9RRT
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Marlborough NH 03455

After years and years of doing product reviews, you tend to get fairly immune to boastful claims from various manufacturers. Of course people tend to exaggerate when they're talking about their own products—this is expected, and you learn to filter out the facts from the hyperbole. Still, some products come along described in such glowing terms by their makers that it's hard to keep an open mind when reviewing the product. As an example, I received the product literature for the Arrow Antenna 146/435 Corner Beam antenna well before I got the actual antenna. Glancing over the spec sheets, I found quite a few phrases that got my attention. Consider the Arrow Antenna motto: "Simply the Best." Or maybe the description of the Corner Beam: "This is an impressive antenna, no matter how you look at it." Or even the relatively humble "Arrow Antennas manufactures a very select line of products." Well, I thought, there's no shortage of hubris in Loveland, Colorado.

A few days later, as soon as I slid the antenna out of the package I had a thought: "You know, these guys might be telling the truth!"

What's a corner beam?

Before going into details, it might be a good idea to review the reasoning behind getting a corner reflector in the first place. In the overall scheme of things, corner reflectors have a spot in the logical progression of antenna evolution. The ordinary dipole gave way to the Yagi-Uda, which utilized directors and a reflector. The single reflector was turned into a screen for a greater back-side rejection. The screen was then formed into a right angle (or a 60° or a 45° angle) to improve the front-to-back ratio, which created the corner reflector. If the reflector is rotated in a full circle around the single driven element you get a parabolic dish antenna. Building a parabolic dish at VHF frequencies can be a tricky maneuver. Due to wavelength dimensions, however, a high gain 2 m or 70 cm antenna is most effectively built using corner reflector methods.

So what does a corner reflector have that a plain old Yagi-Uda doesn't? First, it's much shorter. A standard beam antenna with the same 10 dB gain as the Corner Beam would have to be 10 feet long. The Corner Beam's longest element is four feet long, making it ideal for mounting and rotating in a smaller space. Second, the directivity is the same or better than a Yagi-Uda with the same gain. Third, the 40 dB front-to-back ratio makes it ideal for nulling out interference from other stations, or for concentrating all of the signal from a transmitter toward a given geographic area. And fourth, a corner reflector has a much wider bandwidth than a beam. As an example, a typical standard beam will have a 2 to 4 MHz bandwidth with an SWR of less than 2:1. The Corner Beam lets you operate across the entire ham band with an SWR of less than 1.2:1—virtually flat. In addition to all of these benefits, the folks at Arrow Antenna

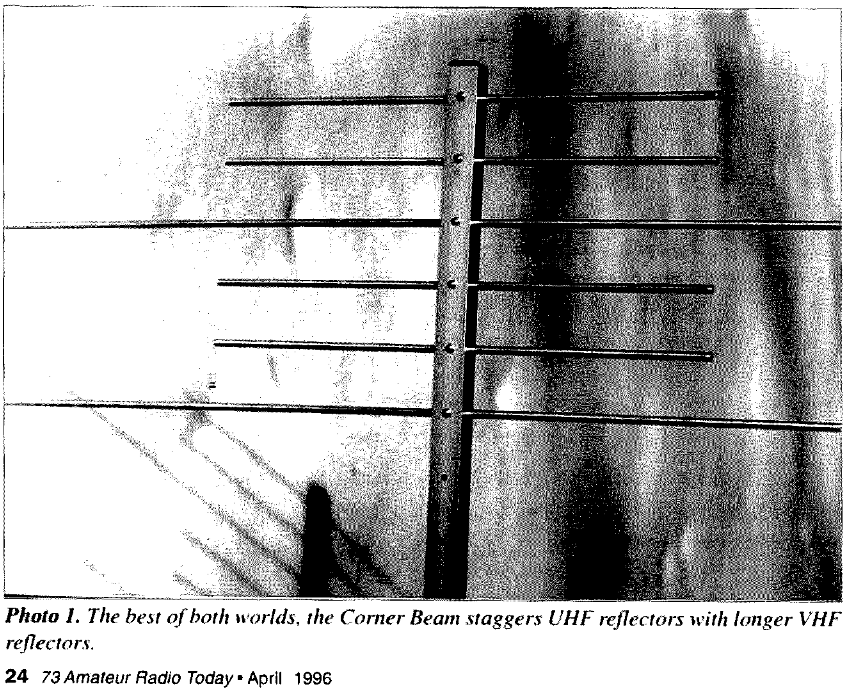

Photo 1. The best of both worlds, the Corner Beam staggers UHF reflectors with longer VHF reflectors.

NEVER SAY DIE

Continued from page 4

Any questions? Okay, now put this down and start doing some serious thinking.

If you don't know how to find out about health, then for heaven's sakes at least send $5 for my list of books "you're crazy if you don't read." There are a bunch of the more important health books on the list. And if you want to find out how to start your own business then you could do worse than invest $5 in my booklet on "Making Money," which I wrote after getting a bunch of requests for it from the Art Bell radio talk show listeners.

One of these days I'll have all that stuff on a web page for you, but until then I can't reprint things I've

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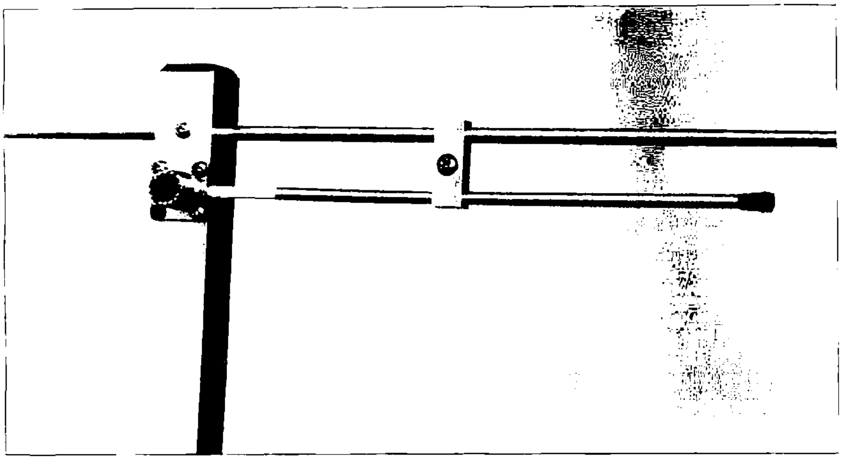

Photo 2. Quality construction is evident in this closeup of the VHF driven element and gamma match.

have created a dual-band version of the corner reflector. The 146/435 consists of two separate corner reflectors sharing the same boom structure. The shorter UHF elements are interspersed with the longer VHF elements, and both driven elements share the center boom. Because of the vast difference in frequency the elements for each band are "invisible" to the elements in the other frequency band, meaning that you can have two high gain, highly directional antennas in the space needed for one VHF corner reflector. You can use them both at the same time if you have separate radios, or use them with a duplexer and a single run of coax with your dual band transceiver.

An impressive antenna?

Once you've decided that a corner reflector is just the thing for your repeater or packet link, is the Arrow Corner Beam the way to go? Is it really "an impressive antenna, no matter how you look at it."? Yes. The quality that goes into the Arrow Antenna products is obvious, from the second you open the package. It comes completely broken down in a 4" x 4" x 4' box. Each of the booms is wrapped in plastic to avoid scratches during shipping, and these are wrapped together with foam packing. Hardware is carefully packaged, and the elements are stored in the boom tubing. The three booms are made of 1" square T-6061 aluminum tubing, a high grade material used in many industrial applications. The reflectors and driven elements are made from quarter-inch solid aluminum rod—not tubing. The gamma match on the driven element consists of a carefully machined shorting bar, along with a plastic insulator for the rod that comes up from the SO-239 (VHF) or N (UHF) connector. Even the design of the gamma match is well thought out—the shorting bar and match are aligned in the plane of the main boom, meaning that the pattern of the antenna will be truly symmetrical. The hardware is all stainless. The documentation is not extensive, but very clear.

Anyone should be able to assemble this antenna in under an hour, using just a Phillips-head screwdriver and a couple of adjustable wrenches. As I assembled the antenna, the quality of the product became more and more evident. All the holes were precisely drilled and completely deburred—all the reflectors slid smoothly through the booms, and all the mounting screws then threaded easily into each reflector. There was no missing hardware, and the gamma matches went together and tuned up easily.

The main boom allows for easy mounting to a tower leg or mast section, in either a vertical or horizontal orientation. (Of course, you can't split the polarity between bands—both driven elements are on the same boom, and both will always be the same polarity.)

But does it work?

Regardless of how well made an antenna is, the proof of the product is in the operating. I already had a three element dual-band Yagi mounted on my rotatable mast. I mounted the 146/435 right below this antenna and borrowed one coax run from the Yagi, running both antennas on 450 MHz. This allowed me to use the switch box to run A/B comparisons. Obviously, the comparison was not totally fair—the Corner Beam has quite a forward gain advantage over the Yagi. Still, the results showed how big a difference a few dB can make. Signals that were barely readable on the Yagi came in loud and clear on the Corner Beam. Signals that were just barely workable on the Corner Beam were simply not to be found using the Yagi.

What can I do with it?

What are some of the applications for an antenna of this type? The fact that the 146/435 is actually two antennas in one, and no more than four feet on its longest side, means that it's a very space-efficient antenna that still gives you the gain of the big beams. If you have a small amount of antenna space the Corner Beam might be just the ticket—mounted on a rotating mast, on a tower leg, to the side of your house, or even tucked in the attic. The great front-to-back ratio of this antenna makes it useful for a lot more than simple home station applications, however. You might have a repeater that needs to cover a fixed area. Perhaps the only hill in your area is way north of town, and you have no interest in covering anything to the north of the hill. Why not concentrate all your power back toward town, instead of spreading signal where it isn't needed? Most repeater groups probably have another repeater on your frequency in the next state that gives you trouble now and again. Why not use the Corner Beam (or two) to null out the interference from the other site? More esoteric applications abound. Corner Beams would make excellent antennas for use with passive repeaters—two back-to-back antennas, used to dribble some signal into areas otherwise unreachable by the main repeater. Any fixed data or packet application would be well served by a corner reflector. How about a VHF/UHF crossband repeater, using only one antenna? Foxhunters will have fun with this

antenna as well. Put the fox in a hard to reach spot, and point the Corner Beam at an easy to reach hill. With very little signal coming off the back of the beam, and lots of signal coming off the hill, all but the craftiest hunters will be kept busy for hours.

Drawbacks

Actually, I could find nothing negative with this antenna. However, one point to consider before you purchase any corner reflector concerns the wind load of the antenna. The wind load of the 146/435 is specified at less than three square feet, which puts it in a league with a 20 element 2 m beam. This in itself is not a problem, but bear in mind that the wind load (and the weight of the antenna) is asymmetrical—all of the wind and weight load hangs off one side of the mast, greatly increasing the amount of torque that can be applied to the mast and rotator. This means that while you can probably get by with an inexpensive TV rotor to turn this antenna, you might run into problems during high winds or icing conditions. The best approach would be to use a heavy duty rotator, or to mount the Corner Beam on your main mast under your HF beam.

Is it "simply the best?"

Is it the best in the whole world? No. If you have a bottomless checkbook you can find some commercial antennas that are even more rugged than the Arrow Corner Beam—at about ten times the price ($165). Is it the best in the amateur market? I think it is. Is it the best bet for gain and quality per unit price? Absolutely. Regardless of your application, you'll be hard pressed to find a better way to spend your antenna dollars. The Arrow Corner Beam uses construction techniques that rival or exceed many commercial antennas, at an affordable amateur price. It's a pleasure to see that a company has taken a stand with quality materials and excellent craftsmanship, and that stands behind its products with a ninety 90 day, no hassle refund policy. In addition to the 146/435 dual band antenna, the Corner Beam is also available in single band versions in 148, 220, and 450 MHz models. Any of these antennas may be obtained through Arrow Antennas and are nationally distributed through Antennas West, Box 50062, Provo UT 84605 (800) 926-7373.

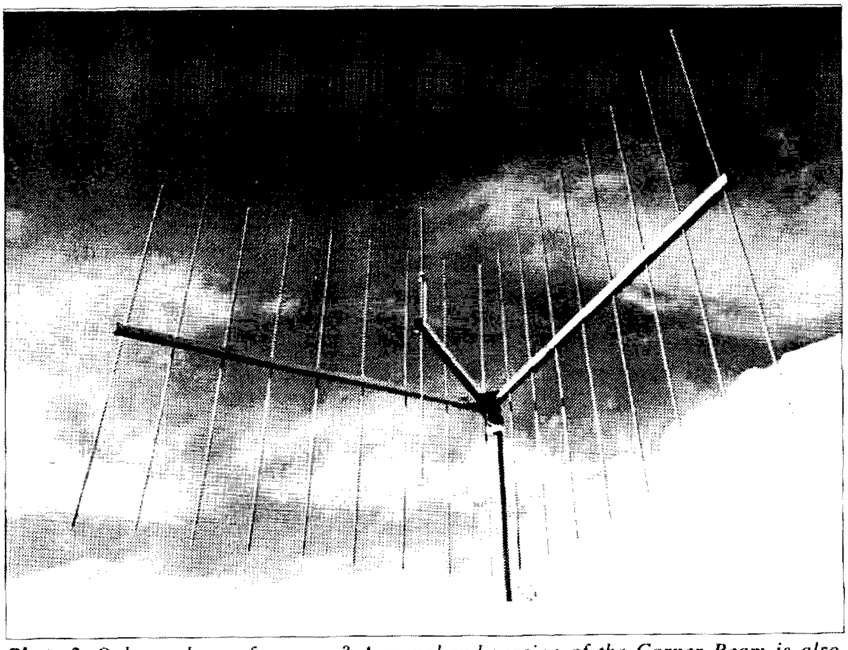

Photo 3. Only work one frequency? A monoband version of the Corner Beam is also available from Arrow.

73 Magazine is looking for talented personnel. If you are literate in English, computers (Mac best and/or others is great), and/or are a ham with technical skills...call Frances. If you have desktop publishing (Pagemaker and/or Quark), marketing, telephone sales, and/or circulation management skills...call Frances. 603 924 0058

Number 28 on your Feedback card

Johnson Matchbox Renaissance

A flea market winner! Or, build one yourself.

John Sehring WB2EQG
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Baker MT 59313

A recent article in *QST* which evaluated a number of different antenna-matching devices caught my attention. The venerable Johnson Matchbox got high marks for efficiency and degree of balance. It was proven to compensate for a fair amount of reactance from an antenna operated off-resonance.

"The Real McCoy" may be hard to find but dedicated hams can build accurate working copies."

I had always wanted a Matchbox in order to feed my large balanced-fed loop antenna with 50 ohm coax on all bands, but I'd never found a Matchbox at ham radio flea markets for the right price. I built a copy of one instead. It was an uncertain affair because I had only a small photo of the innards of a Matchbox to guide me. Matchboxes are somewhat hard to find (they haven't been made for about 35 years) so I think that others might want to build accurate copies. Mine is the version of the Matchbox that is conservatively rated at 275 watts (a kilowatt-rated model was also manufactured).

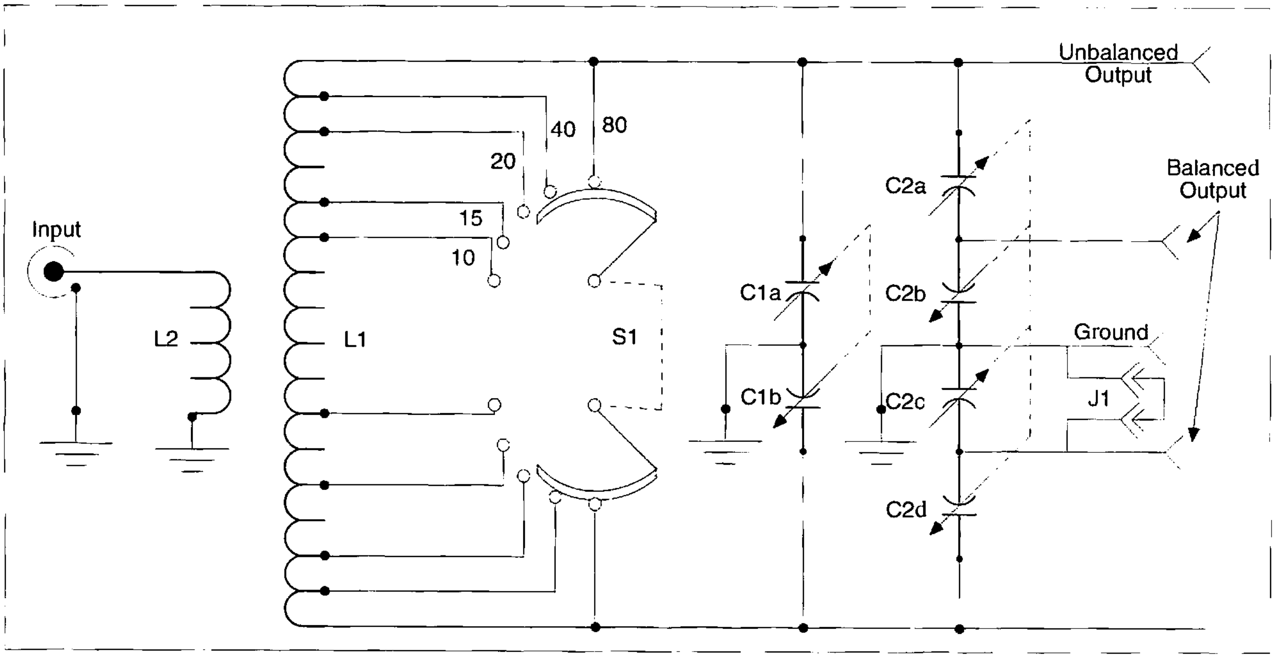
Main Coil

The construction of the main coil (L1) is unusual: the two ends of the coil are wound with a smaller turn spacing than the middle section. The coil is symmetrical in construction as it is intended to be connected to a balanced line. The pitch of the two end sections is 8.5 turns per inch. This is equal to a center-to-center wire spacing, between adjacent turns, of about 0.12 inch. Each end of the coil contains 14.75 turns.

The pitch of the center section changes to 4.3 turns per inch in about one-quarter turn (90°) of the coil. This gives a center-to-center wire spacing between adjacent turns of about 0.23 inch. The center portion contains 5 turns.

The length of the entire coil (two end sections plus center section) is 4.5 inches; its outside diameter is 2.7 inches. The entire coil is air wound on

Continued on page 47



Ham Radio and Summer School

The 1995 session at Sno-Isle.

Larry R. Luchi W7KZE
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I was hooked after being introduced to amateur radio in the sixth grade, and have been licensed for more than 40 years: the 1980s brought a career change, and now, as an Electronics Technology instructor at Sno-Isle Skills Center in Everett, Washington, I spend my time teaching my hobby.

The Skills Center, serving 25 area high schools, is the largest of nine Skills Centers in the state, with 22 vocational training programs for approximately 850 students. The school's name comes from the combination of Snohomish and Island counties. From the school one can see the Olympic Mountains to the west and the majestic North Cascades to the east, just 25 miles north of Seattle.

Some students take the ferry from Island county and others are bused from the 13 school districts served by Sno-Isle, for two three-hour blocks of daily instruction (a morning class and an afternoon class). These students receive three elective credits per school year for their training. In the third quarter of this two-year program, I teach amateur radio (communications electronics). All of my students have Novice, Technician Plus, or higher-level licenses by the time they graduate from high school.

Photo A. Sarah, Larry W7KZE, Allan Falkner, talking with Frank W8OK on 20m. Visoth Sieu looking on.

For the past 10 years I have also taught a summer school course in ham radio. My summer school course not only helps kids to get their amateur radio licenses, but also introduces them to electronics in a hands-on training environment.

"My summer school course not only helps kids to get their amateur radio licenses, but also introduces them to electronics in a hands-on training environment."

Summer school is fun. The superintendent of public instruction allocates funds each year for a 90-hour, one-half credit course of instruction for students from the ninth through the twelfth grades. The only costs to the students are bus fare and lunch.

About five years ago, while teaching summer school, I had the pleasure of meeting the Guru of the Dayton Amateur Radio Association, Frank Schwab W8OK. Frank was visiting his daughter, Pat Anderson, and family in nearby Lake Stevens. (Pat is one of 12 children; I asked Frank how he had time to help create the Dayton Hamvention in 1958 with all those kids!)

This year's projects

Summer school this year had 19 students. As usual, I asked all my students to tell the class about themselves and why they are attending summer school. To my surprise the first student was Sarah Anderson, Frank W8OK's granddaughter. The second student to speak up was Allen Falkner; his parents, James and Phoebe Falkner, WA7VQO and KA7WPG, wanted him to become part of a "ham family." After the introductions, I explained the course of instruction and issued each student a copy of *Luchi's No-Code Technician Class License Guide*. Soldering was the first skill that each student was to master; then we moved on to the code.

I used *Super Morse* on my PC. To the kids it was almost the same as a video game. Ninth-graders Sarah Anderson and Dustin Hebner mastered this approach to learning the code quickly. They both passed the 5 wpm exam at our volunteer examiners' session.

To add to the fun, I gave the kids two kits to build and take home at the end of school. One was a code practice oscillator kit. John Fluke Manufacturing Company donates these kits each year to my program, complete with a printed circuit board. The second project was an AM-FM receiver kit that the students built. This provided a break between code practice, rules, regulations and electronics theory lectures, and gave the students some hands-on training.

I also organized the kids into work teams. One team replaced N-connectors on our AOP Oscar antenna array while another team relocated our AEA IsoPole 2 meter antenna and replaced the PL-259 coaxial connectors. All the students rotated jobs to receive as much exposure as possible to the different aspects of ham radio.

Back to the ham shack for a schedule with Sarah's grandfather, Frank W8OK, on 20 meters. Now it was time for on-the-air practice. Sarah eagerly waited to talk to her grandfather. W8OK came through with a 59 signal. He gave us a 57 for my Kenwood TS-50 to a four-band three element beam. Sarah was the

first to exchange greetings with Frank, followed by the other students. Only one student was a little mike shy.

On the final day of summer school, certificates of completion were passed out as our volunteer examiners prepared the test. Sarah, Dustin and Matt Watson passed their 5 wpm test. Seven students passed the code and Elements 2 and 3A for their Technician-Plus licenses, and three passed Elements 2 and 3A for their no-code Technician licenses. Summer school 1995 thus was a very rewarding experience for me and my students.

After all exams were graded we held our final schedule with W8OK on 14,270-kHz. Frank came through with a strong signal and one question. "How did the test go?" I handed the mike to Sarah and she told her grandpa the good news. Then all of the students made their first QSO with W8OK. Frank talked to our Elmers and thanked them for all of their help.

Our summer school ham radio program was successful, with help from the electronics industry and Elmers from the community. Del Talf W7EVI, who was first licensed in 1935, and Dave Johnson NJ7Z and Jeff Fasulo N1HBQ, both from Boeing, completed our VE team. These Elmers gave the kids the help and encouragement they needed to become good amateur radio operators.

Photos by Bob Higbee, Sno-Isle Skills Center counselor.

Photo B. *Sarah Anderson (left), W7KZE with son Anthony (right), Visoth Sieu. Note: Sarah is looking at her mother as Frank attempts to tell Pat (Sarah's mother) which is his favored daughter.*

Publisher's Note:

Permission is granted to copy this article for use in influencing school boards and administrators on the value of adding a course in modern communications technology to their curriculum, summer and winter.

Since we're well into the electronic age, this is a terrible time to keep our kids ignorant of the fundamentals of electronics and radio. These are the days of digital compact discs, of digital television, digital cameras, digital broadcast radio, direct satellite broadcasting, paging services, cellular phones, security systems, global fax, and the world wide web. Amateur radio provides an exciting and fun way of learning the basics of these technologies, with our network of thousands of repeaters covering the country (and in over a hundred other countries), with our digital packet networks, our bulletin board services (BBS), and our two-dozen-plus ham satellites.

Amateur radio and computer technology have come together with weather satellite pictures, slow scan TV, packet, radio-teletype, and high speed Morse Code contacts.

Electronics runs our typewriters, our manufacturing machines, our cars, our watches, our offices, and even our kitchens. Medical electronics is a huge business today. Thus, the earlier kids can learn to understand the fundamentals of electricity and electronics, the better opportunity they're going to have to cope with the information age. And what better way to learn than by having fun every inch of the way via amateur radio?

A knowledge of electronics provides a tremendous boost in self esteem for kids. They learn hands-on by building kits. They build confidence in communicating with people by talking with hams in almost 400 different countries. They learn about geography. Most people may not have a clue as to where Lesotho is, but hams even know the radio prefix (7P8). Look up 7P8CA and you'll find that's me! Because of my interest in amateur radio I've operated from Swaziland, Sarawak, Sabah, Sweden, Spain, South Korea, Syria, Switzerland, Sudan, Sri Lanka, South Africa, Singapore, Scotland, St. Pierre, St. Lucia, and other wonderful places around the world. I was FO8AS on Tahiti, VR2FD on Fiji, 5W4AS on Western Samoa, JY8AA in Jordan, and so on.

Speaking of Jordan, the reason that country is the foremost in technology in the Arab world is because the king (JY1) has set up amateur radio stations and clubs in almost every school in the country. How has Japan beat us so thoroughly in so many electronic industries? Every school in Japan has an amateur radio club. There are over twice as many Japanese radio amateurs as Americans, with half our population. When I visit the Japanese electronic research laboratories, I'm greeted by radio amateurs at every turn.

Every American youngster should be taught about electricity, and what better way than via a hobby which provides a lifetime of fun, learning and adventure? It can also be one of the more inexpensive hobbies, with kits and used equipment keeping the cost low. There are hundreds of "hamfests" all around the country where hams get together to swap equipment and parts.

Youngsters of four have gotten their Novice licenses, and girls of seven have attained the Extra Class license, the highest class available, so the hobby is open to kids of all ages. The only thing lacking is the opportunity for kids to get together with older hams as teachers. That's up to local schools to organize. They will find no shortage of local ham volunteers to mentor the kids. We call it "elmering."

Alaskan Amateurs and Their Antennas

Amateur radio way up North.

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In the summer of 1994 I toured Alaska. In 29 days I visited more than 90 hams in 15 different localities, and I took more than 640 photographs. I wanted to see how they cope with the weather and the unusual propagation prevailing on the top of the world. (Somebody suggested studying the correlation between the long winter nights and population growth, but I decided that is none of my business. I don't care what they do in the privacy of their igloos, as long they answer my QSL cards.)

Some facts of life up north were as I expected; others were revelations. I knew, for example, that the Aurora Borealis, or Northern Lights, can wipe out radio communications even during the best propagation periods, but the thing that most surprised me was the very warm weather I encountered in the Fairbanks vicinity, at about 100 miles south of the Arctic Circle. I also found out that the seemingly endless rain in Southeastern Alaska can be very depressing, but I will focus here on a single subject: the antennas used by Alaskan hams.

Photo A. Bill KL7ITI in Anchorage.

"Radio communications is not just a hobby; it is an everyday necessity."

First, as can be expected, the antennas, towers, rotators and cables have to be ordered from suppliers in the "Lower 48" states, or occasionally from Canada. Everything has to be shipped long distances and costs go up. Then, because of strong winds, the antennas have to be well built and the towers have to be secured with strong guy wires. I didn't see one single quad antenna, which is an excellent performer, but doesn't resist high winds well. I noticed many wire dipoles, especially for the 40, 80, and 160 meter bands.

Has anybody seen my yagi?

The vast majority of the antennas for the 10 to 40 meter bands I saw were three- to six-element yagis. Most of the antennas were installed on tall, well anchored towers, a few on steel pipes. In Anchorage I saw three-element yagi type antennas of Bill KL7ITI; Harvey NL7DK; Rick KL7YF and his wife NL7DL; Chuck KL7PJ and his wife Marge KL7YG. Simon NL7VR and his family of hams are using a five-element tribander. John KL7GNP runs the Alaskan QSL bureau, and uses a six-element beam. Harley KL7IZZ and his spouse Arlene KL7HO share a huge six- element tribander.

On the roof of the five-story Pioneers' Home, a retirement and nursing home in Anchorage, is a three element tribander connected both to the club station and to the private station of Allen KL7GU. Jim KL7CC has not one but two towers in his backyard; each supports various yagis with three, five and seven elements, and some wire antennas.

The most fascinating antenna I saw in Anchorage was built by Mike KL7X. It consists of four groups of four yagis, each with six elements, and is used for Earth-Moon-Earth communications. Mike worked 30 DX countries and almost finished his Worked All States on EME.

In Palmer, Nate KL7DJE installed his six-element tribander, as well as a couple of other antennas, on a tower that seems to be about 70 feet tall. In the back yard of Bob NL7ZG, the president of the Mat-Su amateur radio club, besides a four-element beam, I saw a complex antenna, possible for EME communications. Unfortunately, Bob was not at home, so I couldn't learn anything about his antennas.

In nearby Eagle River, Hannelore NL7EA and her husband Mark KL7TQ use a six-element yagi.

Also using a six-element beam are Bob KL7AM and his wife Luisa WL7BNX in Fairbanks. In the same city, Chuck K7JUT/KL7 has a four-element tribander, mounted on a self-supporting 70-foot tower.

In the town of North Pole, up the road from Fairbanks, Eric KL7AJ and his 16-year-old son David WL7NK operate with a three-element beam installed on the top of a 30-foot steel pipe. Not far away is Joel WL7AI; he has a three-

element yagi and his repeater antenna on a very tall and well-anchored tower. Also residing in North Pole is the ham family of Ed KL7XD, his wife Sandy WL7PQ, daughter Danielle WL7QW, and two sons, Bill KL7TC and Mike KL7YY. They have two large towers, each with a couple of yagis.

The most fantastic setup I ever saw belongs to Rich KL7RA, on a 20-acre estate in Chena Hot Springs. His contest station has seven towers, some of them over 200 feet tall, each with beam antennas for a different band.

The club station of the US Coast Guard Station in Kodiak, KL7HKX, has two towers; one with a seven-element yagi, the other with two antennas: a four- and a three-element beam. Both antennas are connected to the station with underground cables. Mike KL7JBV, Chief of the Kodiak Fire Department, has a tower and a five-element tribander. Chuck WL7EM easily climbs up his anchored tower, about 60 feet high, to reach his three-element tribander. Also in Kodiak, Henry KL7ALJ has a six-element yagi on top of a 70-foot solidly-anchored wooden pole.

In Juneau, the state capital, Rick N6IV/KL7 shares a three-element tribander with Herb WL7BIL and his spouse Cynthia KL7IZE.

In Auke Bay, George W3ML/KL7 has a four-element tribander on top of a tower erected on the shores of Auke Lake.

In Sitka, Sal KL7BJC has a four-element beam; Leo NL7XW is using a three-element tribander; and Bill AL7KX has a four-element yagi and a couple of other antennas on the same tower.

In Petersburg, Ed KL7DYS and his wife Mildred WL7ALG share their six-element tribander. Their house, with the tower and beam, is only a couple of yards from the water of the Inside Passage, which should make radio communications easy.

In Ketchikan, Chris KL7GIH has a six-element beam for 6 meters, his favorite band, and a wire antenna for 160 meters. Hank KL7IBG uses a five-element tribander.

A seldom-seen antenna is the one designed for satellite communications. Simon NL7VR has one in his back yard and is using it for Oscar-13. A similar setup is the antenna system operated by Jim KL7CC. Both of these hams live in Anchorage, the largest city in Alaska, where most of the active amateurs reside.

Rubber Duckie, you're the one!

In Alaska, recreational vehicles and boats are everywhere, and every one is equipped with some sort of radio. Buildings bristle with vertical antennas, most of them used by CBers, and in the coastal towns, for marine radios. Radio communications is not just a hobby; it is an everyday necessity.

The most commonly used antennas in Alaska are the little rubber duckies. Technician licensees cannot yack on the lower bands, and nowadays 10 meters is rarely usable, so they limit themselves to HTs and operate on 2 meters and 70 cm. Even the higher category ham operators have, besides the big station at home and small ones in their car, truck, boat or plane, one or more HTs. In some instances, when there are several hams in a family, everyone uses them.

In Kodiak at the US Coast Guard station I met Dean WL7RK, a helicopter pilot, his wife Alesia WL7RL, and their son Brian WL7RJ. All three have their own HTs and dune buggies; they travel convoy style, and they are in constant radio contact even when they are only a few feet apart.

Joe WL7AML, in Kodiak, can use his HT with the rubber duckie to talk with hams in Homer, 140 miles away. The trick is that he has to climb on Pillar Mountain and place his radio in the proper position in front of a 60- by 60-foot dish abandoned by the military. A little duckie can do wonders in the right setting.

Matt WL7LX, in Petersburg, may leave home without his American Express card, but never without his HT. It's used on his little boat when he's going fishing, in the bush when he's hunting, and it's small enough to run with if he spots a bear.

The USCG Cutter *Sherman* I saw in Juneau is equipped with all kinds of antennas and sophisticated communications gear. However, crew member Slade KC4WVL uses his little HT with a modest rubber duckie to contact other hams wherever the ship takes him.

Other frequently seen amateur radio antennas are the 2 meter and the dual-band mobile antennas installed on cars, pickups, motorhomes, and boats. Dave KL7M is a taxi driver in Anchorage and makes QSOs while working. Joe NL7RX, in the same city, works on a tow truck; I had a contact with him while he was picking up a wrecked car.

Photo B. Chuck K7JUT/KL7 in Fairbanks.

Verticals for amateur radio? I saw just a few. In Kodiak one is used by Curt AL7LQ; in Juneau by Don WL7ME, and by his neighbor Curtis WL7PX; in Homer by Clarence WØURD/KL7; in Palmer by Jack AL7HN; in Sitka by Hal KL7BCS; in Petersburg by Ed WL7CFZ; in Wrangell by Bob KL7JCZ and by Doug WL7LR.

Solid radio contacts, besides needing good operational skills, favorable

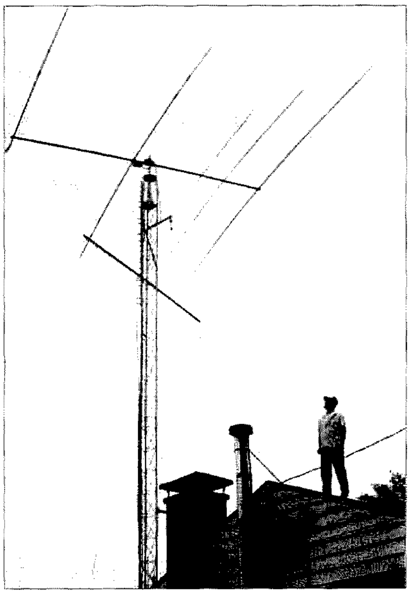


Photo C. Bill AL7KX in Sitka.

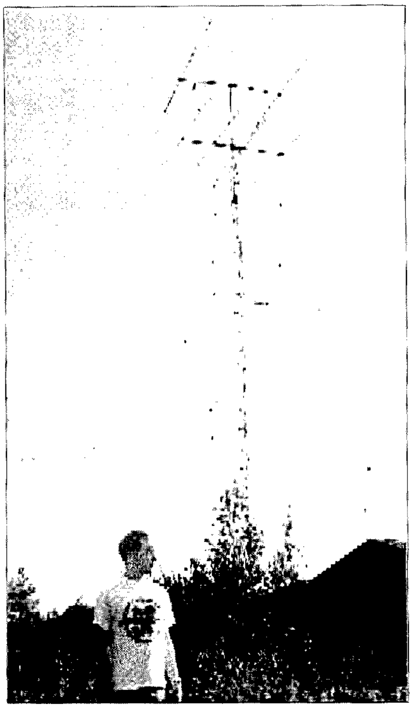


Photo D. Bill KL7TC in North Pole.

location and propagation, also require reliable equipment: antennas, receivers and transmitters. Of all the investments an amateur radio operator can make, the choice of antenna is the most important, and Alaskan hams know it well. Remember, however, the old saying: If your antenna didn't fall last winter, it wasn't high enough.

The photographs show some of the antennas I saw in Alaska, but keep in mind that these little photos cannot begin to show the real scope of a 100- or 200-foot tower with a couple of huge five- or seven-element yagis on the top!

Easy to Build 10m

Continued from page 23

coax from dipole assemblies #3 and #4. Connect the last 5' 5-1/2" coax into the coax "T" and terminate the coax into the SO-239 chassis mount on dipole #1. Complete the assembly by connecting transmission feedline into the center terminal of the coax "T" using a PL-258 coupler.

Parts List

- 24 PVC Schedule 40 1/2" "T" plastic lawn sprinkler fittings
- 24 PVC Schedule 40 1/2" 1-inch long plastic pipe sections
- 12 3" adjustable stainless steel hose clamps
- 4 1 x 1 6' aluminum angle (for the element support)
- 4 1/2" x 10' aluminum tubing for the elements
- 4 3"X2" 3/16" thick Plexiglas™
- 2 "U" bolt type clamps
- 4 SO-239 chassis mounts for RG-8U coax
- 3 M-358 "T" coax adapters
- 1 M-359 right angle adapter
- 1 PL-258 coupler
- 16 Phillips 3/4 inch long sheet metal screws
- 1 Small can of PVC cement
- 3 Lengths of RG-8U, each 1/4 wave long, PL-259 connector at each end
- 2 Lengths of RG-8U, each 1/2 wave long, PL-259 connector at each end
- 1 Suitable 10-foot boom

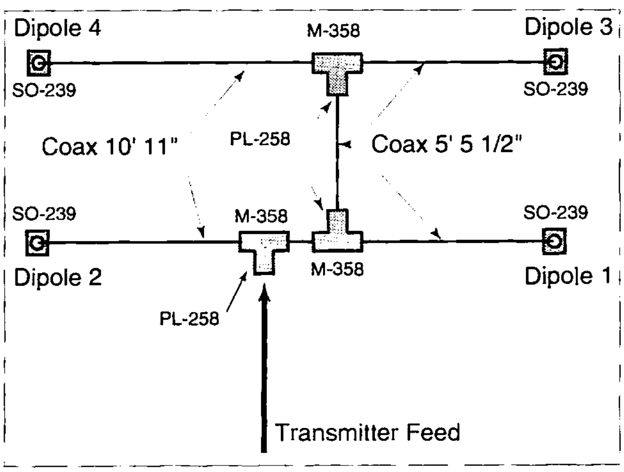


Fig. 3. The coax road map.

Never Say Die

Continued from page 25

published in past issues of *73* just because you don't keep my thousand-plus old editorials on file and cross indexed. Most of the stuff in my booklets originally appeared in my editorials at one time or another.

Can I get you to think things over and decide to make some major changes in your life? A diet change for you and your family will eliminate the problem of degenerative illnesses. It means eating different food and water, and adding the vitamins and minerals that have long been gone from our soil. It means daily exercise. Maybe a job change to something more fun. Some ham radio challenges...like perhaps getting on the ham satellites. How about finding a better school for your kids? Most public schools suck.

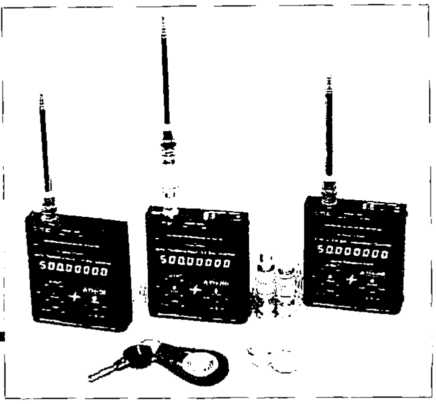
Are there some skills you'd like to build? Books you'd like to read? TV you can do without? In the long run will you be better off for having watched a rented old movie or in reading a book? Or is what you're doing today so much more important to you than your quality of life ten, twenty or 50 years from now?

Continued on page 37

Number 36 on your Feedback card

73 Review

Startek ATH-50 Frequency Counter



Functions, features, and fun!

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Now that the prices of some handheld frequency counters are dropping to the $100 range, more and more hams are finding themselves in the market for one. Let's look at the ATH-50 Counter from International. This top-of-the-line unit has all the functions and features you could want in a piece of handheld equipment. By reviewing each of these functions you'll be able to decide which ones are more important for your application, and you'll be able to make a more informed decision when you make your frequency counter purchase.

The basics

At the basic level, frequency counters do just what you'd expect—they count frequencies. The first question you need to ask is, "What frequencies do I need to count?" As a general rule, the higher the frequency you need to count, the more deluxe the frequency counter needed, and the higher the price. The ATH-50 will count frequencies up to 2.8 GHz, making it useful for work on the 23 cm band, as well as on 2.3 and 2.39 GHz.

If you don't venture beyond 2 meters you might be totally happy with one of the other units in the line that have a high limit of 1200 or 1500 MHz. However, one point that is frequently overlooked is the low side of the frequency range. While most of the line starts counting at 1 MHz, the ATH-50 has a low range limit of 5 Hz! This means that in addition to being a full-featured RF frequency counter, this unit can perform audio functions, making it ideal for checking and adjusting CTCSS encoders, DTMF encoders and decoders, checking packet modem tones—anything down to a resolution of 1 Hz. This low frequency mode is only available on the ATH-50, but it might be well worth the money in your particular application, even if you're sure you're never going to venture beyond 2 meters.

The next specification to check out is the unit's sensitivity. Compared to a receiver, a frequency counter is a fairly low-sensitivity device. By design, a frequency counter operates mainly in the near-field region of a transmitter. (The near field translates to about a hundred feet for a 2 meter handheld.) This means that the strongest signal wins—and gets counted. How else could the counter differentiate between the hundreds of weak signals available between 5 Hz and 2.8 GHz bombarding its antenna?

> ***"This makes it very easy to capture frequencies without even looking at the display, eliminating the need to jot down frequencies as soon as they're counted."***

On the other hand, if the counter isn't sensitive enough, it won't be able to count a frequency until you're right on top of the transmitter. This would be okay for some test bench applications, but pretty useless for fox hunting or investigative work. The ATH-50's sensitivity varies with the frequency being counted, but for most of the bands of interest (10 - 800 MHz) the sensitivity is less than 2 mV.

This sensitivity represents a good compromise between the ability to count distant signals and the disadvantage of hearing too many signals so the counter becomes confused. Depending on your application you may choose to select a unit with a higher or lower sensitivity, or you might choose to add an accessory that will increase the "effective sensitivity" of the unit on a given band. We'll discuss those accessories later on.

Another feature to consider when buying a counter is the type of gating used. Gating is simply the counter's method of letting a certain amount of signal pass into the counter circuitry at a given time, in order to measure it properly. All counters use a hardware gating circuit that controls the gating based on signal level, just like high-end professional counters. This produces an extremely fast response time, on the order of 80 ms to gate, capture, count, and display an accurate frequency.

In contrast, some microprocessor-based counters use a sample-and-compare method, meaning that successive samples are compared until a match is found (or several matches in a row) and then the match is displayed as the correct frequency. While a valid method, the sample-and-compare counters can't match the fast response times of the hardware-gated counters. Again, this may not be a problem on the test bench, but it may be an issue when DFing a repeater jammer or tracking down an elusive intermod product.

It's easy to focus on the off-the-air performance of a frequency counter and totally forget the in-circuit uses of the device. Counters are quite handy for measuring the frequency of in-circuit oscillators, both in receivers and transmitters.

NEVER SAY DIE
Continued from page 35

I have so much I want to do that I could fill a 300-hour week. I've recently read some fabulous books I want to tell you about. And I've got a bunch more stacked up to read. I want to set up a small lab and do some research for a new product that every person in the world will want to buy. It's a product that will help every person who buys it to be healthier and live longer. The FDA will hate it, as will the AMA, the National Cancer Institute, the NIH, AIDS activists, the Medicare and Medicaid bureaucracy, and so on.

That's what I plan to do. Now, how about you?

Bug opportunity

I sure wish I had a bunch more readers like Alan Glowinski WA9EVE. Alan sent me some great newspaper clippings. One on several families whose kids died of leukemia from living near power lines, another on a micropower impulse radar

Continued on page 39

Unfortunately, you can't simply hook a scope probe up to your counter and start probing around in your receiver; the 50 ohm input impedance of the counter will load down the higher-impedance oscillator circuit, causing it to "pull" the crystal off frequency or kill the oscillations entirely. The ATH-50 has a special high-impedance mode on the 5 Hz to 50 MHz range that allows you to use the counter in-circuit, without disturbing the circuit under test. This 1 megohm impedance is the same value as that found on Tektronix scopes, and can be used under the same circumstances.

Don't forget the physical characteristics when considering a counter. The counters all sport high-efficiency, high-brightness LEDs. Easily readable from across the room, they're also readable in broad daylight—and they take the same or less current than comparable LCD counters.

The ATH-50 and all the models come packaged in anodized aluminum cases, utilizing threaded machine screw bushings. (If you expect to give it more abuse than the case can take, just pick up the optional carrying case.) And last but not least, always consider the worst case scenario. What if the thing breaks? All counters are covered by a 5 year parts / 1 year labor warranty - and the high-intensity LED's are covered for 5 years, parts and labor.

The frills

Once you've determined which basic frequency counter features are important to you, it's time to check out the more advanced features. The ATH-50 has several functions that make using it an enjoyable experience. The first of these is the built-in bar graph RF signal strength meter. While a field strength meter is nothing new, they have only recently begun to be incorporated in frequency counter designs. The field strength meters consist of a ten-segment LED bar graph, located right above the main display.

The bar graph display operates independently of the counter, and displays the level of the strongest signal present. Perhaps the most common use of this signal strength indicator is to tell the operator when the counter has enough signal for a good reading.

Another excellent use of the RF signal strength meter would be during a foxhunt. Small, lightweight, easy to see in the dark, quick responding—these counters would be great for use during the "end game" of the hunt. In addition to giving a field strength indication, the counter display will give a confirmation that you're homing in on the proper carrier, in those cases where the fox is hidden near a second transmitter.

The feature that makes the most difference in daily operation, and the one that really differentiates the ATH-50 from most bench-style counters, is the Automatic Trigger and Hold Circuitry. Rather than returning to zeros after displaying a signal, counters with the ATH function hold the last valid count until the next signal comes in.

This makes it very easy to capture frequencies without even looking at the display, eliminating the need to jot down frequencies as soon as they're counted. An automatic clean dropout feature ensures that a valid count is received before the last count is overwritten, to prevent "garbage" displays.

"Yikes! The local FM broadcast station was at this site!"

The ATH function, combined with the 80 ms response time of this counter, makes it possible to capture frequencies that would totally escape detection without these features. The ATH-50 also has a simple hold switch which locks the current display until the switch is changed, and a one-shot mode that operates in conjunction with the ATH mode except that it locks on and holds the first valid frequency, and holds that frequency until reset, regardless of subsequent signals.

The add-ons

It's time to consider the available accessories. The accessories most likely to enhance the operation of your counter are band pass filters. These small filters are installed in line with the counter's antenna, and pass a band of frequencies of interest.

Suppose you're trying to use a frequency counter at a crowded mountaintop radio site. You want to count the frequency of a 440 MHz ham repeater, but the frequency counter is confused. It hears the 440 MHz machine all right, but it also hears the 30 MHz paging transmitter, the 155 MHz police base, the 72 MHz RF link, and several of the 800 MHz cellular phone channels. By installing the proper band pass filter, most or all of these other signals can be reduced or eliminated, allowing the counter to produce a valid count on the band of choice.

Band pass filters are also useful for general off-the-air counting, anytime you know what band you're interested in. By eliminating signals in other bands the filters reduce the overall RF noise floor, improving the effective sensitivity of the counter for the frequency you're trying to count. In difficult situations, band pass filters can make the difference between a solid count and garbage. Startek offers four different filters: DC - 60 MHz; 130 - 500 MHz; 400 - 1500 MHz; and 800 - 2000 MHz models. Each of these offers less than 1 dB of insertion loss over the passband, and attenuates out-of-band signals by at least 25 dB, and much more on some bands.

As an example of the usefulness of these filters, I was recently called upon to track down some interference on a nearby mountain. The site was fairly crowded, radio-wise, and one of the commercial 450 MHz repeaters was trashing the 2 meter ham repeater, probably because someone had mounted the commercial rig's antenna right on top of the ham antenna. Unfortunately, we couldn't tell which one was the culprit.

At the site, I flipped on the Startek—it displayed 107.9. The LED bar graph showed six or seven segments lit—a pretty healthy signal. Yikes! The local FM broadcast station was at this site!

The bandpass filters would save the day. I reached into my pack and pulled out the HP-400, which passes frequencies in the 400 to 1500 MHz range. Putting this filter in line with the antenna dropped the signal strength to one or no bars, just about eliminating the FM broadcast signal. Now the 450 MHz commercial repeaters began popping up on the display, and I was able to quickly identify the rogue transmitter.

The performance of the counters can also be improved by using an antenna tuned to the frequency band of choice. Startek offers several antennas, as well as probes, cases, and a special interface cable for the MFJ-207 Analyzer.

Frequency counters have come a long way in the last few years, in terms of both features and pricing. The Startek ATH-50 represents the finest model in the line, and would make a good choice for anyone interested in a full-featured frequency. Designed and manufactured in the USA., the unit is available from Startek International, Inc., 398 NE 38th Street, Ft. Lauderdale FL 33334. 1-800-638-8050.

NEVER SAY DIE

Continued from page 37

system which presents endless opportunities for anyone with their antennas up looking for them. And a third, which is a real corker, on a new way to clean bacteria from water without using chemicals, heat or radiation.

This is a real simple approach which makes good sense and it's been tested and confirmed at Idaho University. So the answer to your first skeptical question is, yes, it really does work.

The process starts out by running the water through a pipe in the dark so that the bacteria shut down their defenses against ultraviolet light. Then you hit them with a 69 kHz high energy zap, which blows holes in their cell membranes. It rips the bacteria apart.

Applications: every home, swimming pools, reservoirs, public water supplies and so on. Imagine what a benefit this can be to third world countries where millions of people die every year from polluted water! There's even a hotel in Acapulco I could name that could use it in their restaurant.

Now, here's the test. Did you read the above, nod your head, and say how interesting that is; period? Or did you say to yourself, hey, there's one hell of an opportunity for almost anyone with some electronic smarts to make some bucks while helping a lot of people to keep from getting sick? Have I had any success at all in getting you to think like an entrepreneur or am I just wasting my time even trying to get you to make money and have more fun in life? Have you taken vows of poverty? Is it a religious thing?

Sigh.

In the last few days I've seen several outstanding opportunities to provide products that the world needs desperately. I just wish I had the time to make some of these things happen. For instance, one is a health product that would virtually guarantee that people could, if they had any interest, live at least 50% longer. Maybe 100%! It's inexpensive to make and could easily be set up with multilevel marketing thousands of people could make lots of money. And a few could make gobs. Watch out Bill Gates and Warren Buffet.

But I go to the trouble to read everything I can and learn about new fields. I seek out and talk with the experts, and then I go to scientific conferences so I can meet and talk with more experts. In the last year I didn't see you at the Boulder ISSSEEM conference in June. I was there. I didn't see enough of you at the Tesla Society conference in July in Colorado Springs, despite my editorials telling you about it. I was there and even gave a talk. Nor did I see you at the January '96 Global Sciences conference in Tampa, where two of the biggest technology breakthroughs of the 20th century were presented. And that isn't hyperbole.

Sure, Dayton is fun, but I can't remember when there has been one single talk there that got me to thinking and gave me ideas. If I missed any, nobody has bothered to write and tell me about it.

If you hear of any scientific conferences you think might

Continued on page 55

Number 40 on your Feedback card

Debunking Some Myths about Antennas, Feedlines & SWR

14 facts to pass along.

Bill Parker W8DMR
2738 Floribunda Drive
Columbus OH 43209

If something is repeated often enough, it will be accepted as true. Incorrect information will never be extirpated, but we can all help to reduce it by being correctly informed and knowledgeable about transmission lines and antennas. Spreading myths and misconceptions about antennas over the radio, while newcomers are monitoring, is how wrong ideas propagate.

Read as much as you can absorb. Think about what the author is trying to convey. Compare different authors' ideas. Attend club meetings that offer programs about the subject. Sooner or later, when installing an antenna or while operating with an antenna system, conditions will occur that seem to defy any and all logical explanations. You will be glad then to seek advice from anyone who will listen to your woeful tale. Here are some facts to help you tell when a misconception is being repeated and believed to be accurate. At first glance they may be hard to accept, but facts they are.

1. A low SWR indication does not necessarily mean that everything is operating properly. It does indicate that the antenna system, consisting of the transmitter, feedline, and antenna, are very close to being properly impedance–matched. Changing frequency without some change in SWR is usually cause for concern.

2. Reflected power does not flow back into the transmitter causing overheating and/or inflicting damage. Mismatched impedance essentially detunes the amplifier allowing damage to occur.

3. No transmission line must be any specific length if a transmatch (antenna tuner) is available. Varying the length of the feedline doesn't change the SWR, but it does change the impedance presented to the feedline-tuner connection.

4. At frequencies below about 35 MHz, when using open wire (low loss) feedline, signal levels due to SWRs as high as about 6:1 will be essentially the same as signals produced by a near perfect 1:1 SWR.

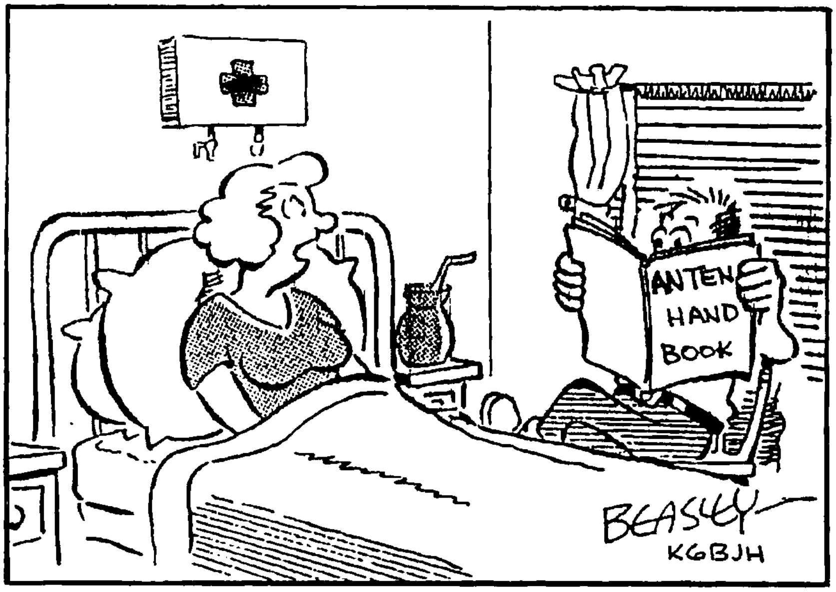
5. Neither the antenna or the feedline must be self-resonant to operate properly. Nearly any feedline and associated antenna may be resonated by using an antenna tuner (transmatch).

6. Using a transmatch to resonate an antenna-feedline system does not change the antenna or the feedline impedances. It provides the required inductance/capacitance to resonate the mismatched antenna system, via reactance canceling, also referred to as conjugate impedance matching.

7. Most losses in an antenna system occur in the accompanying transmission line. The ohmic losses due to very small diameter conductors are an obvious exception. Nearly all antennas are quite efficient radiators.

8. For low-loss transmission line, an SWR meter placed anywhere in the line will read the same value. At the antenna, at the transmitter, or somewhere in between yields the same reading.

Continued on page 59



***Toon 1:** Maybe next time you could bring a copy of* Ladies' Home Journal!

73 Review

Number 41 on your Feedback card

The Alpha Delta DX-A 160-80-40 meter Twin Sloper

Okay, so you don't have a 200 acre farm.

John Stevenson AC4JO
4576 Monaco Road
Memphis TN 38117-6132

The first thing you, as a new ham, should do, is sell your house and buy enough land so you can set up a decent antenna system. Since the XYL may inexplicably veto this very practical solution to your problem, some compromises may be necessary. My yard is only 55 x 100 feet, including two pecan trees and power lines, which made the top band contacts for 5B-DXCC difficult.

After trying dipoles, slopers, and reading every antenna article I could find, I gave up and bought an Alpha-Delta DX-A Twin Sloper at Dayton. It is designed for 40-80-160 meters, with one leg of the sloper a quarter wave for 80 meters and the other a quarter wave for 40. It has a coil partway down to provide a quarter wave on 160. Like all slopers, the wires make one half of the antenna and the tower makes the other half. The 80 meter leg is 67 feet long. The 40 and 160 section is 70 feet. The antenna is rated for full legal power and comes preassembled.

The instruction sheet made the installation simple. I installed the predrilled center connector as high on the tower as I could, with the wires stretched sloping to the ground. My lot's shape forced me to put the two elements at about a 90° angle rather than the 180° recommended. Using my MFJ Model 249 SWR Analyzer, I easily trimmed the antenna to resonance. Both sections resonated slightly below the band edge. After trimming, I was pleased to find the antenna was 1.5:1 from 1810 to 1850, from 3750 to 3850, and from 7050 to 7250. Out of curiosity I tried out 17 meters and found it resonant just above the band.

"The Alpha-Delta DX-A Twin Sloper is designed for 40-80-160 meters, with one leg of the sloper a quarter wave for 80 meters and the other a quarter wave for 40."

When I got on the air the first thing I heard was 9G1BS 5/9 working split on 7075 and 7175. I worked him on the first try and got a 5/9. Then, trying 80 meters, I worked VP5/JA7MQD and XE1L, with 5/9 both ways. The next day, using a Drake MN-2000 antenna tuner, DL4VCG/HC8 and VP2EE were weak, but workable on 17 meters. I'd say it's a darned good antenna!

The N1IR Tree Antenna

Yes, this is *the April issue...but this is a* real *antenna, not a joke!*

Chip Cohen N1IR
2 Ledgewood Place
Belmont MA 02178

This "biological antenna" may be the most peculiar antenna you'll ever hear of . . . and it works!

In the last few years, I have been designing and building a variety of new and exotic antennas; specifically in the field of fractal antennas, which are built around those exotic shapes showing up just about everywhere. The new antenna described here was inspired by some theoretical (model-based) work, in which mathematical "fractal trees" were found to be high gain antennas. Also, I was aware that real trees had been shown to be VLF resonators about 15 years ago. In *QST* I'd seen old reports of trees poorly resonating at 40m when tuner-fed. Would they work at *any* communications frequencies? I decided to put my scientific skepticism aside and let my curiosity take over.

Fact: Real live trees *are* antennas. But before you exchange your antenna farm for a tree farm, keep in mind that real trees are mediocre-to-good antennas which only seem to work at VHF and UHF. Here's how to "build" one.

"Real live trees* are *antennas."

First, find a tree 15 to 20 feet tall. Bring your coax to the ground at the foot of the tree and firmly hammer a 1-foot ground rod into the soil about 2 inches from the trunk. Attach the braid to the ground rod. The rod should only be visible an inch or two above the soil. Next, hammer a 1-inch nail into the trunk, about 2-4 inches up and close to the ground rod. Connect the center conductor onto the nail. If you wish, you may place a ferrite collar at the feed to assure that it's your tree that's radiating. See Photos A and B, which show my connection to a 20-foot oak tree, and the tree antenna itself.

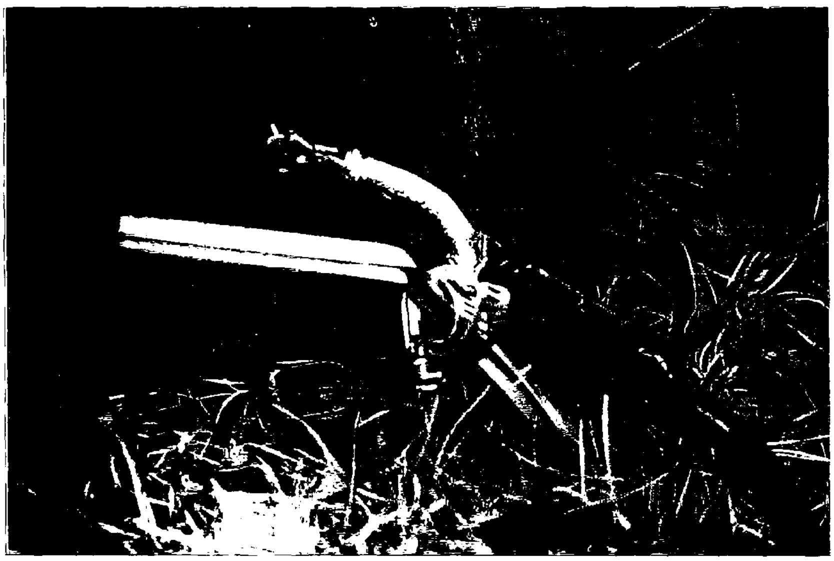


Photo A. *The author's connection to a 20-foot oak tree.*

Now go and operate. You will find that the "tree antenna" resonates broadly (less than 2:1 SWR) from about 120-175 MHz for a 50 ohm feed. It is mostly resistive, and not reactive, near 2m. You'll have a 2m antenna—without the antenna! The tree antenna seems to perform roughly 2 dB better than a 1/4-wave duckie (based on a direct comparison). Don't expect it to perform like a high ground plane, though—it will easily be 8-12 dB below even a modest, raised commercial ground plane vertical antenna. A true gain antenna it's not—but it's nature's free gift to the VHFer. Here, near Boston, my tree antenna is on a hill and I get into the Derry, NH, repeater (K1MNS) and the Carlisle, MA, repeater (W1FC) full-quieting with 1 watt. That's 40-45 miles away. Same story with DX packet on K1EA, which easily connects from 35 miles with a watt. My results may not be typical, though, because of my elevation. If there's a repeater 10-15 miles away, a tree antenna should be adequate in most locations.

To double-check my results I had to establish that it was the *tree* radiating, and not the coax (all of which was on the ground). I loaded the ground only; no dice. Then I disconnected the hot conductor from the tree and watched the signal go away. I fed the tree with different lengths of coax—from 1 inch to 100 feet—and noted the (minor) SWR changes. The MFJ 259 SWR analyzer

was handy for this. I minimized the length of unshielded coax at the feed to a few inches or less; a very high SWR would show *this* to be the radiator. Finally, I placed a ferrite collar on the coax at the tree to stop coaxial radiation, and then used an IC Engineering field strength meter on a pole to confirm that the radiation was emerging from the tree and not the ground. Maximum near-field readings came from the lower trunk and upper branches.

The tree seems to resonate by virtue of its height. This might also be expressed by its trunk diameter, since a thick trunk goes with a high tree. I found, roughly, that the resonant frequency goes as the formula:

$$f = 150\,(D)^{-0.20}\text{ MHz} \quad [1]$$

for D, the trunk diameter, in inches. The resonance is of very low Q. I measured a Q of about 3 for several different trees (mostly maples and oaks) . The lowest resonance I attained was about 100 MHz for a 1-1/2 foot (trunk diameter) oak tree. Keep in mind that I had no equipment capable of checking VLF resonances, just as I suspect that the previous investigations had not checked out VHF possibilities. The tree worked poorly when fed by a tuner on 40m and 20m; it was basically a dummy load at HF.

To explain the tree radiator, it is tempting to use fractal theory. Such a broad resonance radiator could easily be explained by a "multifractal spectrum," indicating that the real tree is not just one fractal pattern, but a variety of patterns akin to one another (clouds are a great example of something with a multifractal spectrum). It is not known to what degree the roots function as "radials." Further work needs to be done to show how the fractality of real trees affects their characteristics as antennas, if at all. Unlike the fractal tree antenna, the real tree antenna is capacitively loading the feed, and is not high in gain.

Why use a tree antenna? Aside from the novelty, a tree antenna is the ultimate stealth antenna. If your neighbor complains about a radiating tree, it's time to cart him off to the funny farm. Imagine the "no antenna" controversy in your town erupting over trees. Time to pull them all down—or defer to the intent of PRB-1! Seriously, though, it is a good emergency antenna, and may be useful for RC-controlled lawn and patio electronics, among other things. And will there be a tree-based repeater soon?

A few cautions: First, *never* use high power on the tree; it could result in a fire. Next, be aware that rain and snow will undoubtedly (temporarily) short out the antenna, or at least change the SWR. Ground conditions also change the resonant frequency, but the resonance is so broad that you will experience only minor 50Ω SWR changes (mine was 1.3:1 at 2M) after it rains.

***Photo B.** The tree antenna itself.*

"The tree antenna seems to perform roughly 2 dB better than a 1/4-wave duckie."

Also, if you *depend* on your VHF link, try a backup antenna (or make the tree your backup). Finally, I am not suggesting a new scientific field where you: "plug in a petunia," or "radiate the radishes." Anything that's water-based will radiate (or at least load)—usually poorly. Because they are tall, stationary, grounded, and don't complain, trees make the best "biological antennas."

On a practical note: *Trees are resonant structures*. Therefore, at VHF and UHF, it's best to get as far *above* and away from them as possible. Your backyard forest is not transparent to RF.

Does being an antenna do anything for the tree? Probably not. Note, however, that trees do *not* resonate well at LF, HF and MF. It is at these frequencies that much of the energy from lightning is discharged. Could being a poor low-frequency radiator help a tree survive lightning strikes? We will never know—unless trees start doing something bizarre, like talking back. And if they do....I'm not listening!

73 Review

The ISOTRON 80

Good things come in small packages.

Jim Bellini K9HKS
817 East 15th Street
Sterling IL 61081

As most of the ham radio community is aware, the amateur bands were not at their best during the months of October and November of 1995. So was that a good time to try to evaluate an antenna? Well, after thinking about it, I believe it was! If it will work under poor conditions we all know it is going to *really* perform under great conditions!

I received a letter from Ralph Bilal asking me if I would like to review one of his ISOTRON antennas and compare it to other antennas that I have had at this location. I jumped at the chance because I have seen the ISOTRON antennas advertised and, frankly, I thought that they were kind of an odd-looking antenna—too small to be effective and, at most, good for someone in an apartment, operating portable, or perhaps in a mobile home park. Was I surprised! (More about that later.)

Ralph said he would send me the ISOTRON 80 antenna, as I happen to be very active on 75 meter SSB. By the way, I have been a ham for about 40 years, so I think I have seen and tried almost every type of antenna that has come along. I especially like to make wire antennas: loops, longwire, dipoles, curtains, etc., and anything that is out of the ordinary. Looking at the picture of the ISOTRON 80, it certainly fits into the out-of-the-ordinary category!

Assembly

About a week passed and I was at home on my lunch break when the UPS truck pulled up. The driver handed me a box that looked too small to contain an 80 meter antenna and that felt as if it must be a box of feathers—it weighed scarcely 6 pounds! I quickly opened the box and, to my surprise, there was hardly anything in it that even came close to looking like an 80 meter antenna. Everything was neatly packaged; nothing rattled around in the box. In fact, each little package was secured to the box with some kind of epoxy. Looking at the contents I admit I kind of chuckled and thought: This is not going to be much of a test—it's too small to do much on this band.

Later that evening I read the assembly instructions and decided that since it was so small I would put it together in the basement. Downstairs we went and in about 20 minutes I had this strange-looking antenna put together.

"This antenna is not just something to use until you can get a* real *antenna—it truly is a real antenna and I would recommend it for any permanent station."

Operation

Well, what now? I had a 10-foot piece of coax so I decided to hook it to the antenna and my TS-440S. To my surprise, the signals were pretty good in spite of being in the basement with an antenna that didn't look like it would do anything on 75 meters (it looked more like a 2 meter antenna).

The next day I considered trying to get the antenna outside and on the tower, but there was about a week of windy, rainy weather, so there was no chance to work with the antenna. I kept looking at it and wondering if I was wasting my time, but my curiosity was getting the best of me. Out to the garage I went and found a couple of sections of TV mast pipe. I put them together and fastened the ISOTRON 80 to the mast pipe. The wind was still blowing and the temperature was around 25°F, so I had to make quick work of getting this antenna into a position where I could see if it would do anything at 20 feet.

Photo A. The ISOTRON 80. Photo by Will Sosa.

I took a couple of sawhorses and made a support to hold the 20 feet of mast and antenna up in the air in the middle of the back yard. It wasn't pretty, but at least it was off the ground.

Back to the basement and the rig. Signals were not bad considering the conditions. I wondered where the resonant frequency was going to be. According to the instructions, without the tuning stubs the antenna should come into resonance around the high end of the band. Much to my surprise, without any adjusting the resonant frequency was 3.940 with a 1.1 to 1. So would the signal get out when the antenna was only 20 feet off the ground?

I was able to work several stations with 58 59 57 reports in the middle of the afternoon. I was interested to see what the signals would be when I checked into the Mid States WX net meeting on 3.940 at 6 p.m. CST that evening. I have been on this net for many years and most of the fellows know what my signal should be. No one seemed to notice any difference in the signal! When I told them what I was using, there was the same disbelief that I had felt when I first saw the antenna.

Switching between the dipole and the ISOTRON, I noticed that the ISOTRON didn't seem to pick up as much noise as the dipole.

The dipole's and the ISOTRON's signals were comparable in the receiving mode. In transmitting, at some times the dipole would run about 1 to 2 S units stronger and at other times my signal was about the same. The

dipole was at 35 feet and the ISOTRON was at 20. I was impressed!

Performance

The next step was to get the ISOTRON up in the air on the tower. Finally. the forecast was for 50°F, so I decided to run a new line of RG58U coax to the tower. I asked the XYL to come out and hold the ropes while I went to the top of the tower, and in a couple of hours the ISOTRON was up at 57 feet. Now for the big test!

Into the shack I went to see if this little thing was really going to do much on the 75 meter SSB portion of the band. I checked again for the resonant frequency and found that the antenna had changed and was now resonant at a much lower frequency, 3.867, with a 1.4 to 1.0 SWR. I use a solid-state rig; I wanted to know what the band width would be as anything above a 2 to 1 SWR causes the output to be reduced. I found that I was at a 2 to 1 SWR at 3.893 on the high side of 3.867, and a 2 to 1 SWR at 3.843 on the low side of 3.867. By using the built-in antenna tuner I was able to cover the whole 80 meter band with no problem.

I am currently using a Kenwood TS-440ST driving a Dentron MLA-1200 amplifier with a Dentron Super Tuner. I was pleased to find that the ISOTRON accepted the 1,200 watts PEP without any problems. (It is rated at 1,000 watts PEP, 500 watts CW, according to the manufacturer.)

I am still stunned at the performance! It exceeded my *wildest* expectations—I was jumping in and out of different QSOs getting signal reports and comparing them to those of the dipole antenna; the ISOTRON was outperforming the dipole, which was mounted at 35 feet! I wondered if it favored a certain direction but found that it is omnidirectional, just as the Bilal Co. .said it would be.

In using the antenna over the past couple of weeks I have found that it has performed above and beyond what I thought would have been possible for such a compact antenna. I think the best report I have received so far was from WØNUJ in Coldsprings, MN, who gave me a report of 59+30, and K9TCC (about 12 miles from me) was running 59+15 with his dipole antenna. I have compared signals many times against the dipole and have found that on stations close in (75-100 miles) at times the dipole was slightly stronger by maybe 1 to 2 S-units. On stations worked over 100 miles the ISOTRON 80 has given me better signal reports.

Some other reviews that I have read of the ISOTRON antennas report that they make great antennas for those who live in restricted areas (apartments, mobile home parks), Field Day sites, or portable sites, and that they are a quick way to get a signal on the air. This is true, but I would like to say that this antenna is not just something to use until you can get a real antenna. This is truly a *real antenna* and I would recommend it for any permanent station.

"I can picture them all on one tower with no wires, control cables or antenna rotors."

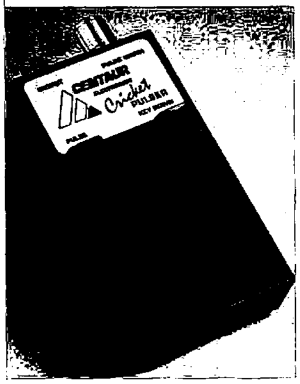
How does it work?

How do the ISOTRONs work so well? For an antenna to work, it should be electrically resonant. The ISOTRONs are made electrically resonant by using only two components: the large coil in series with the capacitive plates of the antennas. (Match comes automatically with the right combination of the two components at resonance.)

There is more that is necessary for an efficient antenna. An antenna needs a certain amount of area to couple radiation to the atmosphere, sometimes referred to as the "capture area." However, this is an *area*. The area can be any shape or form. The laws of physics for this phenomenon do not specify appearance. The ISOTRONs have this radiation area. They exceed or equal (depending on the model) the area of a conventional half-wave dipole (#12 wire). In simple terms, the Bilal Co. has designed the ISOTRONs into a three-dimensional package. The performance speaks for itself! I'm pulling the dipole antenna down at this QTH and the ISOTRON 80 is going to be *the* antenna. In fact, I'm wondering about the other bands-160, 40, 20, 17, 15, and 10. I can picture them all on one tower with no wires, control cables or antenna rotors.

Number 46 on your Feedback card

New Products



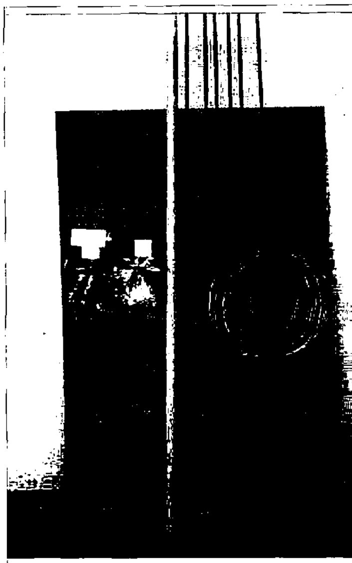
Cricket Pulser Eases Tuning Stress

If you want to tune your transmitter without running it at full power, Centaur Electronics offers the Cricket Pulser as a way of limiting wear and tear on your equipment without sacrificing tuning accuracy.

The pulser connects to the rig's CW key jack. Depress the pulse button and adjust the duty cycle for the desired pulse width. For example, if you set the pulse width at 10%, the 1.5 kW amplifier will think you are only running 150 watts, but the full power will be there in pulses, allowing you to use any relative or peak-reading watt meter to tune.

There's also a key-down switch to allow you to run continuous-power tests.

For more information, contact Centaur Electronics at 3720 S. Park Ave, #604, Tucson AZ 85713. Phone: (520) 622-6672. FAX: (520) 622-1341.



Antenna Kits from Cubex

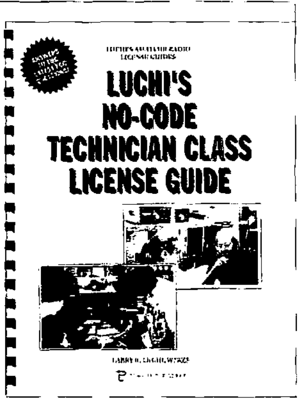
The Cubex Antenna Company has released two new VHF-UHF antenna experimenter kits. The kits contain all the parts needed to build experimental antennas customized for specific applications.

Each kit contains a Fiberglas boom, quarter-inch spreader arms, copper tinned antenna wire, antenna wire notches, insulated feed block, PVC or aluminum boom mast coupler plate and miscellaneous stainless steel hardware.

The kits come in two boom sizes: either 4 feet by 1 inch, or 8 feet by 1.25. The four-foot version costs $29.95 plus $6 shipping, and the eight-foot goes for $69.95 plus $12 shipping and handling.

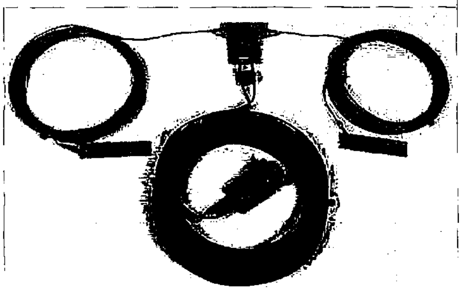
The address is Cubex, 2716 Sturn St. Unit E. Brea CA 92621. Phone (714) 577-9009. FAX: (714) 577-9124

No-Code Tech Class License Guide



Larry Luchi W7KZE has been at it again with this 160-page 1995 edition of his Tech license guide. Latest question pool. Answers. And good explanations so you can take the test understanding what it's all about instead of trying to memorize hundreds of Qs & As. None of this stuff is very difficult to learn, and you'll need to have a good grasp of the fundamentals to go on to your General license. Unless, of course, you are a gutless, wishy-washy, namby-pamby dullard with no ambition to do anything but kerchunk our 2m repeaters, thus settling for about 1 percent of the adventure amateur radio has in store. No offense intended. Tiare Publications, Box. 493, Geneva Lake WI 53147.

A New Price On an Old Favorite

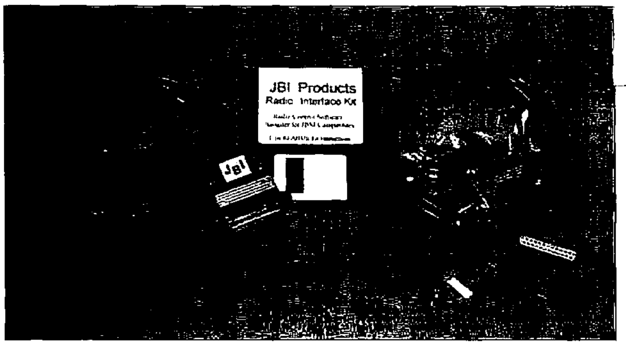


MFJ Enterprises has managed to cut the price of the old reliable G5RV antenna to less than $30. The MFJ-1778 is the latest version of this popular wire all-band antenna.

The antenna is just 102 feet in length – less than the length of a full-sized 80-meter dipole. As a sloper or an inverted vee, it's even more compact. With an antenna tuner, you can operate from 80 through 10 meters. With an antenna tuner and a ground, it will even operate on 160 meters.

MFJ's version of this antenna comes fully assembled and ready to handle full legal power for $29.95. The setup includes 102 feet of antenna wire, 32 feet, 6 inches of 450-ohm ladderline terminated with an SO-239 coaxial connector.

The address is: MFJ Enterprises Inc., PO Box 494, Mississippi State MS 39762. Phone: (601) 323-5869.



Computer-Transceiver Link Announced

JBI Products and Technologies has announced a new computer-radio interface that allows hams to control their radio equipment with a PC compatible computer.

The interface works with units by Kenwood, Yaesu, Icom, Heathkit and Ten-Tec that are designed for computer control.

Johnson Matchbox

Continued from page 28

four narrow plastic spreaders which run the whole length of the coil. They are located every 90° around the circumference of the coil.

The main coil is tapped at approximately 0, 8.8, 12.7, 14.6 and 15.5 turns from each end; the tap at 0 turns means that the entire coil is used. This gives 80 through 10 meter coverage, respectively. 17 and 12 meters are covered but not 30 meters. 30 meter coverage could be provided by an additional tap between the 40 and 20 meter taps.

Link Coil

Wound over the center section of the main coil is an unbalanced input link coil (L2).

The link is wound with the just about same pitch as the center section of the main coil. However, its outside diameter is larger, 3.0 inches. It contains four turns.

The link coil is positioned coaxially with and over the center portion of the main coil. It has an adjustable tap—about 1.25 turns up from ground gives around 50 ohms output impedance. Using all the turns of the link gives in excess of 300 ohms impedance.

Both coils and all the wiring is made from 12-gauge, tinned, solid-copper wire.

Switch

The switch (S1) for selecting coil taps is a rotary unit. It has two poles with five positions (Johnson No. 22.884). It is a successively shorting design, although I'm not sure if this is strictly necessary. The switch is not large—it's about 1.75 inches in diameter. The two switch sections are located on opposite sides of 3/16-inch thick ceramic insulation. In my home-brew version, I just used alligator clips to tap the coil.

Capacitors

There are two variable capacitors. They are both rated at 3 kV peak using 0.075 inch plate spacing and ceramic insulation.

The first one (C1) is an ordinary dual gang unit, with 10 to 100 pF of capacitance per section (Johnson Part No. 154-505-4 [100ED30]).

The other capacitor (C2) is set up as a two gang, dual differential variable, also 10 to 100 pF per section (Johnson Part No.169-25 (100EDA30)). Adjusting a dual differential capacitor causes one section to increase in capacitance while the other section decreases. For example, as the capacitance of section C2a is increased, that of section C2b will decrease (ditto for sections C2d and C2c, respectively). For this circuit, the rotor of this capacitor needs to be insulated from the chassis.

My home-brew version of the Matchbox was built on a metal plate resting on a wooden chassis. The manufactured version comes in a 10 x 10 x 8-inch high metal box.

Tuning Up

Tune up is simple. Install an SWR bridge between the transmitter and the matchbox with short pieces of coaxial cable. Select the correct coil tap for the band to be used. Using the lowest possible power input to get an SWR indication, juggle both variable capacitors for the lowest SWR. There is interaction between the capacitor adjustments.

Or, to be more considerate of others on the air, connect an antenna noise bridge to a receiver. Set the noise bridge to 50 ohms resistive, then adjust the tuner for a dip in noise in the receiver.

Performance

Using my particular antenna (a 275-foot long closed loop, roughly triangular in shape, approximately parallel to and about 25 feet above the earth, fed with 25 feet of home made 600 ohm open-wire line), I'm able to achieve very nearly a 1:1 SWR on all bands. Current balance, as indicated by an RF ammeter in each leg of feed line to the tuner, is excellent though my loop is not symmetrical. The Matchbox circuit provides at least 15 dB of harmonic attenuation as it is a resonance circuit. It gives some preselection for the receiver as well. You'll realize this when you have to retune every several hundred kHz or so on 80 and 40 meters if you want to keep the SWR low. I don't find this a serious inconvenience, since I made up a calibration chart giving frequency vs. dial setting.

Continued on page 59

Number 48 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

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Stevenson MD 21153

The accumulated showers of e-mail and letters this month are threatening to make a messy desk messier, if that is possible. So, let's look at what some of you have had to say.

Evaristo F. Nievera N2MBC enjoyed the review of ham radio Internet sites in the October RTTY Loop, and writes that he is just learning the ropes of the Internet, and had looked everywhere for amateur radio sites or home pages, only to find the information here in RTTY Loop. Formerly DU1EN, Rickey received his U.S. call five years ago and continues to stay in touch with Philippine news through the Internet. He has tried several of the commercial services, including CompuServe, Prodigy, and America Online, but prefers a direct connection through an Internet Service Provider for economy and speed of transmission.

He adds that since we are in the bottom of the sunspot cycle, with propagation at a long-time low, the Internet presents a threat to amateur radio. His current activities include packet and PACTOR, and he is looking into color transmission with PACTOR.

Well, Rickey, while I share your concerns about computer communication affecting amateur radio, perhaps the death knell is a bit premature. After all, the same could have been said of the telephone, other broadcast media, or even, as once was forecast, the citizen's band. But we're all still here. With new frontiers to conquer, and new techniques to explore, I think ham radio will lead us into the next millennium.

Then there was all the input on the question of sound boards and digital modes. Johan Forrer KC7WW fills us in on the origin of a term questioned in a previous column. "PSA" stands for "Personal Sound Architecture" and was coined by Analog Devices for a three-chip set: an ISA bus interface chip, a 16-bit stereo CODEC (the ubiquitous AD1848), and a ADSP-21xx family DSP chip. Several sound board manufacturers have used these on their sound boards. Unfortunately, this technology has already been made obsolete by the introduction of newer versions of the chipset. Echo Speech Corp, for example, now has the latest ADSP-2181 and a new ISA interface that offers WIN95 plug and play hardware and software.

Meanwhile, Rob Glassey GØVTQ (Robert.Glassey@nmp.nokia.com) writes the following: "I've been corresponding with Erwin Cremers about DSP software using a Soundblaster™ card and he mentioned you as someone who may be working on this kind of software. I'm interested in corresponding with anyone working in this field, since I am writing Soundblaster DSP programs too. My current project is a Soundblaster-based Ham Radio HF data modem. So far I have written code to demodulate RTTY to the screen, with tuning and input level indicators. This works, but is still in the very early stages. My ultimate aim is to TX/RX RTTY, AMTOR, PACTOR and possibly PACTOR II, both FEC and ARQ modes. I'd also like to try out some highly robust modes such as the second generation of CCW/BPSK for extremely low SNR comms (portable QRP DX)."

While I am not working on such a project, I am reasonably sure that at least one of the readers of this column (other than you) is., so I look forward to the establishment of a match, and feedback of any progress. Good luck.

One of the wonders of amateur radio is the international nature of the hobby. A site for "serious DXers" can be found at: http://promet12.cineca.it/htdx/—Mirko Caserta, IKØZSN, is the "Awards Page" manager. These pages contain the latest information about Italian Ham Awards, along with plenty of details about satellites, DX news, contests, and the like. This is both an attractive and useful page. Check it out.

Mark Walker N9HCI wrote that he was troubled with the version of Hamcomm he was using. "Got a copy off the net, looks really neat, except the tones do not go high enough to be usable. 2000 Hz is the top end for the generated tones. Any ideas? My only other choice is an old TU I have which generates RS232 on RECV OK, but would require some means to modulate the 120mA loop with the ±12v from the serial port's TXD line. Any sources you may recommend would be appreciated. Mark."

I dropped Mark a note telling him that the actual tones should not matter... just the difference between them. Not knowing which version of Hamcomm he had, I sent him version 2.2, which is on disk #5 of the RTTY Loop Software Collection, to try out.

His response: "The new Hamcomm works great." The moral? If a version of the software you are trying does not seem to work, look around for a new version.

An unsolved problem comes from Dave N3AAT, who notes that he has a Delta 2/Level Controller and Macintosh Portable. He wants to know what he has to do to get onto RTTY, whether he needs a controller, or if there is a software solution.

On a related note, Bob Castaneda KC7QR asks: "Maybe you can point me in the proper direction? I'm looking for a "good" RTTY program for this Macintosh Centris-650 computer that I'm now using. And maybe (but down the line) an SSTV program that will work on this too. I've been a ham since about 1972 and for most of that time it's been on RTTY. Have worked WAS, WAC, DXCC-RTTY, and some other stuff, most of it on the "old" model 15s and 19s. Found an excellent program for the Apple IIe computer for RTTY but don't have much room here in this small shack for more than one computer, so would like to find an RTTY program for the Mac. But if I can't find one, I guess I'll just have to hook up the old He again, huh? Hi."

Well, guys, unfortunately, I have very little Mac software. I know there is quite a bit out there, though. You might check on AOL, in the Ham SIG library, or on CompuServe, in HamNet. By now, I shouldn't have to hint to share the findings with us over here, should I?

Ray Ortgiesen WF1B advises: "I think folks interested in the RTTY loop page may want to surf (oh I hate that word) over to my page. It's got some assorted RTTY stuff on it. http://ids.net/~wf1b/home.html is Ray's site. Check it out, you may well enjoy it."

Speaking of Web sites, there is the home page of RTTY Loop at http://www2.ari.net/ajr/rtty/. One of the more popular features of the page is the library of old columns. Bill Howell N5ALO asks if it would be possible to have access to earlier issues? "If these are just sitting around on disk somewhere, wouldn't it be easy to plug them into the Web page?" Yes, Bill, it would be easy, but space consuming, and I have a limited amount of space on my server. I am trying to put up columns, downloads, and information useful to the readers of the column. Feel free to drop me a line, via e-mail or snailmail, if you have any suggestions.

Luis XE2MXU/N5UHB passes along his congratulations on the new web page. "It's good to see that at least one of the columns of *73* is on the web now. Now if we could get the rest of the magazine in there..:)" I can't speak for the rest of the magazine, Luis, but I look forward to sharing with all of you this way for a long time to come.

We've covered the past and future this month, along with plenty of your input. I always look forward to your cards, letters, and e-mail. Reach me via snailmail at the post office box above, or via e-mail at ajr@ari.net, MarcWA3AJR on America Online, or 75036,2501 on CompuServe. More next month, with plans to highlight some recent RTTY and related equipment.

Number 49 on your Feedback card

Hams with Class

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Staten Island NY 10313-0006

Technology and no life

I recently read a terrific article written by one of my favorite writers: Unknown. I chuckled so long and hard over the truisms that I decided to share them in my "Hams With Class" column. I'm sure that teachers and instructors of amateur radio who read my column will find appropriate use for this "ice-breaker."

You know technology has taken over your life when:

1. You have never sat through an entire movie without at least one device on your body beeping or buzzing.

2. Your stationery is more cluttered than Warren Beatty's address book. The letterhead lists a fax number, e-mail addresses for two on-line services, and your Internet address, which spreads across the width of the letterhead and continues to the back. In essence, you have conceded that the first page of anything you write *is* letterhead.

3. You need to fill out a form that must be typewritten, but you can't because there isn't one typewriter in your house....only computers with laser printers.

4. You think of the gadgets in your office as "friends," but you forget to send your mother a birthday card.

5. You disdain people who use low baud rates.

6. You use the phrase "digital compression" in a conversation without thinking how strange your mouth feels when you say it.

7. When you go into a computer store, you eavesdrop on a salesperson talking with customers....and you butt in to correct him and spend the next 20 minutes answering the customers' questions, while the salesperson stands by silently, nodding his head.

8. You know Bill Gates' e-mail address, but you have to look up your own Social Security number.

9. You sign Christmas cards by putting :-) next to your signature.

10. Off the top of your head, you can think of 19 keystroke symbols that are far more clever than :-)

11. You back up your data every day.

12. You think jokes about being unable to program a VCR are stupid.

13. On vacation, you are reading a computer manual and turning the pages faster than everyone else who is reading John Grisham novels.

14. The thought that a CD could refer to finance or to music rarely enters your mind.

15. You go to computer trade shows and map out your path of the exhibit hall in advance. But you cannot give someone directions to your own house without looking up the street names.

16. You would rather get more dots per inch than miles per gallon.

17. Al Gore strikes you as an "intriguing" fellow.

18. You own a set of itty-bitty screwdrivers, and you actually know where they are.

19. While contemporaries swap stories about their recent hernia surgeries, you compare mouse-induced index finger strain with a 9 year old.

20. You are so knowledgeable about technology that you feel secure enough to say "I don't know" when someone asks you a technology question, instead of feeling compelled to make something up.

21. You rotate your screen savers more frequently than your automobile tires.

22. You have a functioning home copier machine, but every toaster you own turns bread into charcoal.

23. You have ended friendships because of irreconcilably different opinions about which is better—the track ball or the track *pad*.

24. You e-mail this message to your friends over the net. You'd never get around to showing it to them in person, or reading it to them over the phone. In fact, you have probably never met most of these people face-to-face.

25. You understand all the jokes in this message. If so, my friend, technology has taken over your life. I suggest, that for your own good, you go lie under a tree and write a haiku. And don't use a laptop. 73

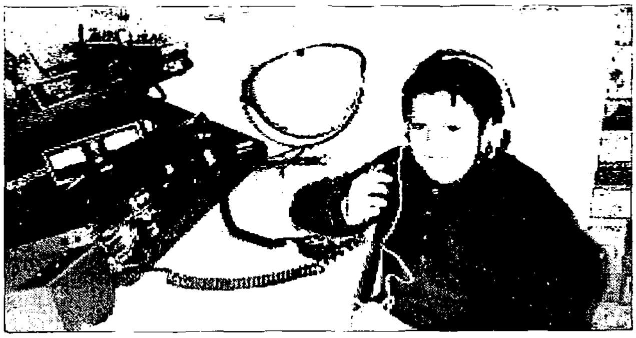

Photo A. *When working with students, try to keep them "balanced" so that technology doesn't take over their lives.*

Number 50 on your Feedback card

HOMING IN

Homing In Radio Direction Finding

Joe Moell P.E. KOOV
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Fullerton, CA 92633

Foxhunting the European way

According to a documentary I saw on "The Learning Channel," the urge to find hidden objects dates back to early civilizations. The children's game of hide-and-seek was played in ancient cities. So perhaps we hams are following a primitive instinct when we set out on hidden-transmitter hunts. Or maybe we are just satisfying our natural urge to compete.

Modern-day T-hunts, as they are called in the USA, usually involve a car full of radio direction finding (RDF) equipment and hours of driving, depending on the hunt rules. Over the years, vehicular T-hunting has gained popularity in England, Australia, and Japan. Elsewhere in Europe and eastern Asia, amateur RDF contesting (ARDF) is just as popular, but nobody uses a vehicle.

While our mobile T-hunts frequently require RDF on foot (called "sniffing") to track down a T that may be a few dozen yards from the road, it's usually a "sniff" from beginning to end in other countries. The international on-foot style of ARDF goes by such names as foxhunting, fox-teering, and fox-tailing. Though it is a sport for all ages, many cities in eastern Europe and Asia include foxhunting as part of Physical Education in schools.

Rules and preferences vary from country to country, but in most cases three to seven transmitters (foxes) are placed in a rural area of 200 to 2,000 acres. They transmit for a minute each, in numbered sequence. CW on 80 meters and AM on 2 meters are the most popular signals to hunt. Runners with direction finding equipment attempt to find all foxes, or as many as they can, then reach the finish line in the shortest possible time. Scores are determined first by number of foxes found and second by elapsed time. Sometimes bright orange and white orienteering flags (called prisms) are placed near the foxes to insure that they are visible. Other groups think prisms are for sissies and allow foxes to be concealed or even buried.

Detailed topographical maps are provided to all competitors to aid them in navigation and bearing-plotting. The sport is so popular in so many countries that regional, national, and international championships are held regularly. To this end, a standard set of rules has been developed by a committee of the International Amateur Radio Union (IARU) to specify the number of foxes, course size, age/sex divisions, fox timing, and the use of prisms.

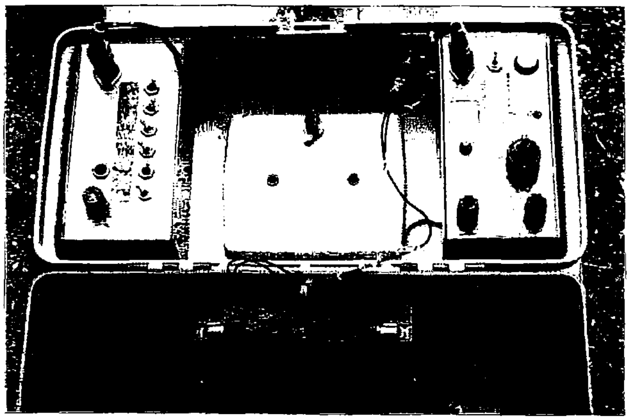

Photo A. This Swedish 80 meter fox transmitter is built into a small toolbox. The timer is designed to be synchronized with six other foxes and can be set several hours in advance. The empty space is useful for storing the antenna wires.

Bavarian beacons beckon

Ewald Stadler DJ2UE of Herrenberg is a very active promoter of ARDF. As a foxhunt organizer for the Deutscher Amateur Radio Club (a national organization in Germany that is similar to our ARRL), he is responsible for competitions of all the local clubs in his district. DARC has an entire subdivision for ARDF; its annual foxhunt calendar includes over 60 formal events.

"In Western Europe we do foxhunting as a club activity," Ewald told me. "It is for all ages. We have between 20 and 70 people coming to each competition. Most of them are over age 30. We also do mobile hunting, but that is in a different division. We don't like the mobilers because they make too much dirt in the air. Vehicle hunts are declining because of problems like road congestion."

DJ2UE continues, "At our contests we always hunt 80 meters in the morning and 2 meters in the afternoon, except for our championships when we have them on two separate days. On 80 meters, you have to know your equipment, the null and front-to-back ratio. But mostly it's running, a sport competition. However on 2 meters, it's a brain competition. You have to be very careful what you do because of the signal reflections. On 80 meters you can stand still and navigate and take your bearing and then go, but on 2 meters, no way! If you stand still and take a bearing, you may be off by 30 degrees."

Vertically polarized longwire fox antennas are the rule on 80 meters, but it's different on 2 meters. According to Ewald, "For VHF foxhunting in the forest, you can't use vertical polarization. The trees are all reflectors, and if you hide it well with vertical, you'll never find it. So we use horizontal polarization. For a four-mile course, it usually takes me an hour to find all foxes. Some hunters take two or three hours depending on how difficult it is. When I hide, I usually make it easy and I don't use very hilly country.

"A problem with foxhunting in Germany is that if you have a large group, say 70 people, they tend to follow one other and it's not a true competition. To solve this we sometimes scatter dozens of little 100 milliwatt 80 meter transmitters in the grass, each with an aerial of about 1 foot length. They transmit only a few feet, so you can find them only when you are close. I draw circles on the map where these transmitters are hidden. Hunters use the map to run to these circles and once inside them they navigate for the fox."

Swedes do it in the woods

There is more foxhunting activity to be found in Sweden than in any other country in Scandinavia. The last IARU World ARDF Championships were held there in 1994. My wife April and I had the pleasure of visiting this beautiful country last summer, where we were welcomed by Per-Axel Nordwaeger SMØBGU and Lars Nordgren SMØOY. Per-Axel, who was the main organizer of the 1994 Championships, took us to a typical forest near Stockholm, where he showed how their weekly foxhunts are done.

P-A, as his friends call him, explained the history of hidden transmitter hunts in his country. "In the 1960s we had something called a triple hunt with two or three people in the car; one to drive, one to read the map, and a third to do the receivers. Today gasoline is about a dollar a liter, so we always do ARDF by running."

NO TRESPASSING signs are the bane of transmitter hiders in the USA. Not so in Sweden, where there is a principle of law called *Allemansratten* (Everyman's Right). It allows every person to move about freely on foot in forests and fields, without worrying about property lines. They can swim, sail, and motorboat on lakes or rivers, and even make camp with a campfire for a night without permission from the landowner. Allemansratten provides Swedish foxhunters with their choice of hundreds of forest locations for ARDF contests, so long as they take care to pick up litter and protect the vegetation.

Swedish forests are a paradise for orienteering enthusiasts because they are hilly with extremely thick vegetation. Often you can't see more than a few feet in any direction. They are full of lakes and swamps. Much of the ground is

covered with small stones. It's hard enough to imagine finding your way in terrain like this in the daytime, but the intrepid Stockholm area foxhunters do it at night! Seven foxes start transmitting at 7:10 p.m. each Wednesday from May to late September. During spring and fall, this is after sunset. P-A says he wears a helmet with a 30 watt halogen headlight on it to help find his way during night hunts.

find 2 meters very interesting because it's so unpredictable," he says. "You end up in many places other than where the transmitter really is."

Simple Swedish 80 meter foxes (see Photo A) use inexpensive color TV subcarrier crystals, putting them on 3580 kHz. A rope thrown over a tree hoists the longwire antenna with one or two ground planes underneath.

"What a wonderful way to let children and teenagers know that computers aren't the only way to have fun with electronics."

"We also come together on a Sunday morning for what we call a national competition," says SMØBGU. "That means that one club organizes a hunt to which other clubs are invited. We use no prisms. Foxes are concealed under leaves or branches. In Gothenberg, they dig down into the ground and bury them. It takes about five hours to put out all seven foxes before a hunt.

"We are not allowed to run in the forest with short pants and shirts," P-A continues. "That is due to an epidemic about 15 years ago of hepatitis, or something similar. Nobody could figure out why only orienteers got the disease. Then they noticed that many competitors ran through the same paths in the forest and got scratches from bushes. Doctors suspected that blood was getting on the branches and being transferred from one runner to another. We changed the clothing requirement and it totally solved the problem.

"During previous World Championships, youngsters from Korea and Japan ran with nearly no clothing at all, even though it was cold with snow. So when we sent out information on our 1994 competition, we included a picture of a runner dressed the proper way so they would understand that someone not fully clothed would not be allowed to run. No one came dressed improperly."

Follow the bouncing signal

Almost all Stockholm area hunts are on 80 meters. P-A dislikes the signal reflections that plague VHF hunts. "I don't

P-A says skywave propagation causes problems during nighttime hunts. "Strong Italian signals sometimes cover our fox signals at the start point. We have to run into the forest and hope we hear them." According to SMØBGU, most hunters use the same receiver design, which is about the size of a cigarette pack (see Photo B). "Two Swedish radio amateurs started building them around 1965," he says. "It has been developed over the years. We can buy them either complete or in parts. The ferrite loop is quite OK. Lars uses a larger loop instead. It is heavier to carry, but gets a sharper bearing null.

"The old-fashioned receivers interfered with each other, so we had to spread the hunters out. Our hunters scatter into the forest two minutes before the first fox comes on. They are allowed to continue to search for two minutes after the last transmitter shuts off. About an hour after the hunt ends, the foxes automatically start transmitting again to help the organizer find them to pick them up."

Each fox has a crystal-controlled timer that P-A says is easy to synchronize. "Using switches, I can choose how many hours and minutes prior to start I will begin the timing. When I have exactly the selected number of hours to go, I run the cable into each fox and push the start button. It starts all the transmitters to count down to zero and then count forward. The display shows actual foxhunt run time. We trust hunters to write down the correct time on their card when they find a fox."

A toolbox-sized container with wires and timer display might look suspicious to a non-ham in the woods. "We had a competition outside Stockholm not far from the new royal castle," SMØBGU recalls. "On that island is the most secret radio installation in Sweden. This competition was very close to that area. We stopped hearing one of the transmitters and went to investigate. It was on a peninsula in a very swampy area between the mainland and the island. Normally nobody would go out there except silly foxhunters, but two young girls came out in a canoe and happened to find it. They didn't know what it was, so they rolled up the antennas and took it home to daddy.

"I had to go to the police to report the theft because it was close to the military installation. In the meantime, the organizer put flyers on lampposts around the area. One happened to be in front of the house where the girls lived. The homeowner saw it and we got it back, but it took a week. Now we put signs on the foxes."

The world awaits us

International-style foxhunting sounds like a great sport, doesn't it? What a wonderful way to let children and teenagers know that computers aren't the only way to have fun with electronics. Since publication of my "Homing In" columns about Hamcon/Foxhunt-95 in Southern California last fall, I have heard from hams who are planning to hold on-foot RDF contests like this in such diverse places as Pittsburgh PA, Daytona Beach FL, Portland OR, and Victoria BC. What about your town?

Organizers of European and Asian ARDF competitions are eager to have entrants from North America. To that end, they have established a special Promoters section in each championship, for countries such as the USA that have never participated in any international ARDF event. Each first-time IARU society may send a maximum of six competitors for the Promoters section, which will have its own special awards.

Photo B. Per-Axel Nordwaeger SMØBGU demonstrates how foxhunters get bearings on 80-meter signals in Swedish forests.

The 1996 IARU Region 3 Championships will be held in Townsville, North Queensland, Australia from July 15 to 20. The 1996 European Championships will be September 1 to 6 in Bulgaria, 45 miles south of Sofia in the Rila Mountains. The next IARU World ARDF Championships will be in 1997, probably in Germany or China. If you would like to attend any of these events and can finance your own transportation to the host country, contact me for information on how to register.

If you're going on a foxhunt in a foreign country, it wouldn't hurt to listen to some language instruction tapes before you go. April and I were pleased to discover that the majority of Swedes know conversational English. However, there are exceptions. SMØBGU tells this story from the 1994 championships: "One of the competitors got lost and ran all the way through the 2 meter area into the 80 meter area. When he realized the problem, he found the main road and stopped a car. He only knew one Swedish word, which meant 'engineers' for the engineering regiment where the competition was headquartered. Unfortunately, he pronounced it wrong and it sounded like another Swedish word that means 'nothing.' The driver couldn't understand him, so he took him to a police station. Fortunately, the police knew what we were up to, so they called the regiment and we sent a car to pick him up."

Keep your cards, letters, and e-mail coming. "Homing In" readers want to know what's new in RDF contesting in your area. Write to the address atop this article or send e-mail to me at Homingin@aol.com or 75236.2165@compuserve.com.

Number 52 on your Feedback card

Ask Kaboom

Your Tech Answer Man

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The end of monitors

For the past couple of months, we've been exploring the repair of dead computer monitors. Let's see if we can finish that up, so next time we can get into something else.

Set 'em up

With any luck, the past few months' columns have helped you to get that dead monitor running. If it's a few years old, though, you may be less than satisfied with the picture. Oh, sure, it was exhilarating to see it finally work at all, but now you want it to work *right*. Setting up a color display isn't hard, but it seems to be a dying art, and is probably one of the least understood procedures these days. I've even met some TV servicers who weren't clear on how to do it.

The elements

The basic elements you have to adjust are image size, geometry, brightness, black level, color balance, color tracking and focus. Wow, that sounds like a lot, doesn't it? Really, it doesn't take long, because some of the adjustments help set some of the others. Let's dive in!

Before we start, I must repeat my previous warning: The insides of TV sets are mighty dangerous! When you're poking your screwdriver inside to get at a control, it is remarkably easy for your hand to touch something. If that something happens to have plenty of voltage on it, you're in trouble. To help avoid disaster, remove your wristwatch and jewelry. If you have any rubber gloves, wearing them can really help. Just be sure to keep your eye on the part of your hand that *isn't* near what you're aiming for, as well as what is. And, of course, wear shoes: the less grounded you are, the safer you are. The old TV shop maxim of putting one hand behind you is still good advice, too, because it prevents your getting shocked across your chest, which is the most dangerous path in your body.

Now that I've terrified you, let's get started. Hook the monitor to your computer and set it up for an average picture. On a *DOS* machine, that would be text; in *Windows*, perhaps the program manager area. On a Mac, the normal desktop is best.

The very first adjustment you need to set is the image size. Unlike on normal TV sets, computer monitors deliberately leave some black area around the edges of the picture, because things can get too fuzzy if the scan goes all the way to the edge of the tube. Typically, 1/4" to 1/2" will be left black. If your monitor looks otherwise, snoop around the PC board until you find the vertical size control. Adjust it until the picture fills all but that desired black border, from top to bottom. If the black areas at the top and bottom are not equal, find the vertical centering control and get the image centered. To set the width, look on the board, in the area of the flyback. Now and then you might find a trimpot for width, but most width controls are coils with ferrite slugs. The coil may not be labeled, but it will probably be the only one in that area of the circuit. Try adjusting it carefully to see if the width changes. (Be sure to use a plastic coil tool, not a screwdriver; if you crack the core, you have a problem on your hands.) Set the width for about the same black areas on the picture's sides that you have on the top and bottom.

If the image is off-center, the obvious solution would seem to be to adjust the horizontal centering control. Most sets do have one, although sometimes it's a jumper wire and three pins you can plug it into, rather than a pot. Before you change any of that, though, look for a trimpot labeled "horizontal phase," or sometimes just "phase." Try that one first, as it will have a bigger effect. Usually, the centering control will be set correctly when it's fairly close to the center of its range.

If the picture looks pretty square, you don't need to mess with the geometry. If the sides bow in or out a great deal, though, look for a control labeled "pin" or "pincushion." Adjusting it will have an obvious effect. You may also find one called "trapezoid," the setting of which will also be pretty obvious. Geometry controls are always a compromise: don't expect to ever get a perfectly square scan on the curved surface of a CRT.

Lookin' good!

Now that your picture is the right size and shape, it's time to set something called the "screen." This is an overall bias adjustment that sets the amount of current which will pass through the CRT, from the electron gun to the phosphor screen, and it affects all three colors (red, green and blue) at the same time. Its primary effect is to fix the black level of your picture; set it too high and your blacks will be gray, too low and your bright areas will be weak and dingy. You'll find the control on the side of the flyback transformer, usually right near the focus control. Be sure to use an *insulated* screwdriver, as the voltages around the flyback are in the thousands. To set the screen control correctly, turn the brightness and contrast all the way down. Now, get a flashlight, and turn the room lights off. Use the flashlight to get your screwdriver in position. Observe the picture, and turn the screen control until you can just see a very dim image. If it looks discolored, don't worry about that just now.

Next, turn the brightness and contrast up to a bit higher than normal viewing levels. Adjust the focus control for best focus at the center of the image, while keeping an eye on the corners of the screen. Small changes in the focus setting will have much more effect at the picture's edges than in the middle, and sometimes you have to compromise a little bit in order to get uniform focus. If the edges won't come into sharp focus no matter what you do, you have to accept that it's the best the monitor can do. Age and condition of the CRT can greatly affect edge focus, and some monitors don't focus well at the edges even when they're brand new. Do the best you can. Generally, PCs demand less of their monitors' focus than do Macs, which present considerably more information on the screen. I've fixed many monitors that looked great on my 386 but awful on my Mac.

Black and white in color

Believe it or not, the best test of a color monitor is how well it can make black and white! Let the monitor warm up for at least 15 minutes, and then set your computer for a black and white image on the screen. If the gray areas look gray, with little or no coloration, you're all done. I'm not talking about fringes of color around objects—that indicates misconvergence, some of which is normal in all color monitors. I'm talking about entire areas, or perhaps even the whole picture, having undesired color. To be sure everything's set right, try turning the brightness down to about 1/3 normal. If the picture turns a different color, you need to set up the color balance and tracking. I make it a matter of course to do that on any hamfest monitor I fix.

This set of adjustments can take awhile, but it isn't hard. Set the black and white picture to low brightness (but not way, way down to where you can barely see it), and find the color controls on the back of the set. Often, they'll be on a PC board attached directly to the back of the CRT. Sometimes, though, the board is mounted behind the tube.

You should have six controls: three for screen (not the same thing as the screen control on the flyback), and three for drive. There are three of each, of course, because each of the three guns (red, green and blue) needs its own set. Sometimes, the screen controls will be labeled "bias." and/or the drive controls will be labeled "highlight," or something similar. It should be apparent which are which, anyway. If you only find two of each, that means one color, usually green, has its values fixed, and you must adjust the other two relative to it. If you find a total of three, chances are your monitor has only drive controls, with fixed screen values. It is easier to adjust such sets.

because you aren't setting the screen controls, but they don't produce color as accurate as monitors with all the controls. I've only seen that configuration once or twice.

The screen controls set the amount of each color you will get in low-brightness areas of the picture. You must adjust them first, because they affect the brighter areas too, at least to some degree. Since your monitor was at one time in good alignment, don't try messing with all three controls; just adjust the one that seems prominent. If you have too much red, for instance, turn the red screen control down until it goes away. If it's already all the way down, you will have to turn the others up to balance with the amount of red. Your goal is a uniformly gray picture.

Once you get it, turn the brightness up to normal and adjust the drive controls for good white in the picture's highlights. Do it the same way, turning only the one that's prominent, and then touching everything up for least coloration. Theoretically, you're all finished. In practice, though, you will find you have to go back and do the procedure several times, because the two sets of controls interact. No matter how hard you try, though, you may find it's impossible to get it exactly right. As long as the picture looks good at normal brightness levels, don't worry about it. But, if you can't get it even close, your CRT may be weak. Sometimes you can get a TV shop to "rejuvenate" a CRT, using a special device, but it doesn't always make too much difference, and, now and then, it can destroy the tube.

Once you've done all this, go back and touch up the focus control. Now, set your computer for a color picture and stand back—you should have a gorgeous image.

And that's the story of, that's the glory of, setting up a color monitor! I'm typing this article on a 14" SVGA monitor hooked to my Mac. I got the set for $5 (it was dead, of course), and it looks as good as any I've ever seen in a store, and better than a lot of them. This stuff really works.

Until next time, 73 from KB1UM.

Three-Element Direct Connect Beam for 2m

A Tiny 2+1.

Edward Oros AC3L
2629 Sapling Drive
Allison Park PA 15101

If the concept of my direct connect antenna ("1, 2, 4 — A Geometric Progression That You'll Love" from the September 1995 issue of *Radio Fun*) caught your attention, you might also be interested in a three-element version of the antenna. (The "Tiny 2" utilizes two elements: the driven element is 1 foot, 7 inches for each side, and the director is 2 feet, 9-1/4 inches.)

As with any standard three-element design, this three-element direct connect antenna utilizes a reflector and a director to achieve gain. As in the case of the "Tiny 2" the front-to-back was sacrificed in order to squeeze as much gain as possible for the antenna. I managed to obtain 6.52 dB over a dipole in free space while still retaining a direct connect antenna.

Right up front you might ask, "Why build this antenna rather than some other design?" The first reason is the very fact that it *is* a direct connect antenna. The design allows you to hook your cable directly to the antenna without the time-consuming process of matching, yet the SWR is just 1.18 to 1. The 6-1/2 dB gain is, of course, a nice bonus. Another appealing feature of this design is the element diameter. Each of the elements is made from 1-inch diameter aluminum tubing. I like the fact that you don't have to play around sliding elements in and out trying to get to the proper lengths. You simply cut each to the lengths shown in Fig. 1 and position the elements on the boom. It is also easy to find 1-inch furniture tips at local hardware stores (they give the antenna a slick professional look).

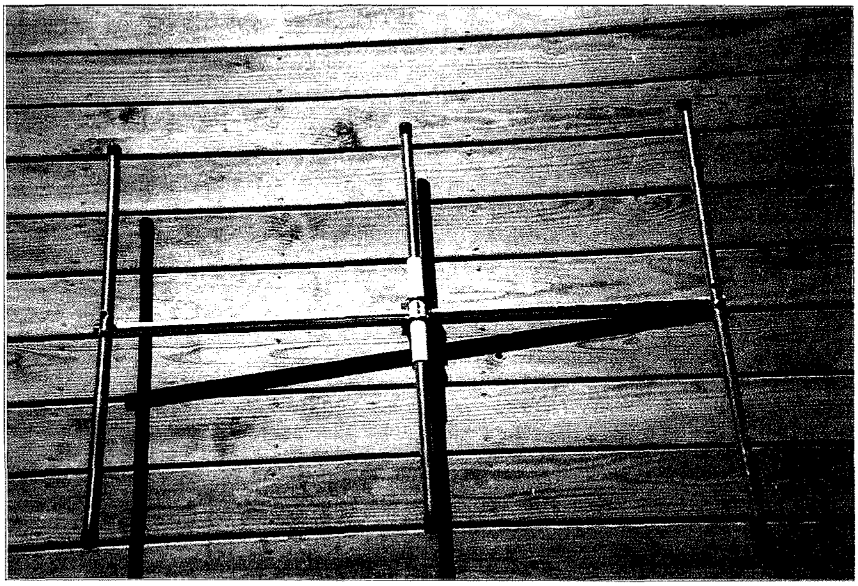

Photo A. It should look like this when you're done.

"Quick, slick — a good pick for first-timers!"

Construction Notes and Hints

You will need a boom length of about 4' 2" even though the distance between the reflector and the director is only 4 feet. The extra space is needed to allow for the use of mounting brackets to hold each element to the boom. As far as connecting the elements goes, any of the popular mounting techniques can be used to attach the elements; you can even use the double bracket clamp method from the "Tiny 2" design if you wish. Center each of the elements by using the center point column illustrated in the sidebar. When mounting the driven element, remember that it is split at the center and must be insulated from the boom; you can use PVC pipe to accomplish this. It helps to insulate the elements, and supports them at the same time.

To Build or Not To Build

There are so many antenna designs out there that it may be difficult to decide which one is worth your effort. The simplicity of this three-element direct connect antenna makes it perfect for clubs and organizations looking for a "first time" antenna project. The proper location for connecting the

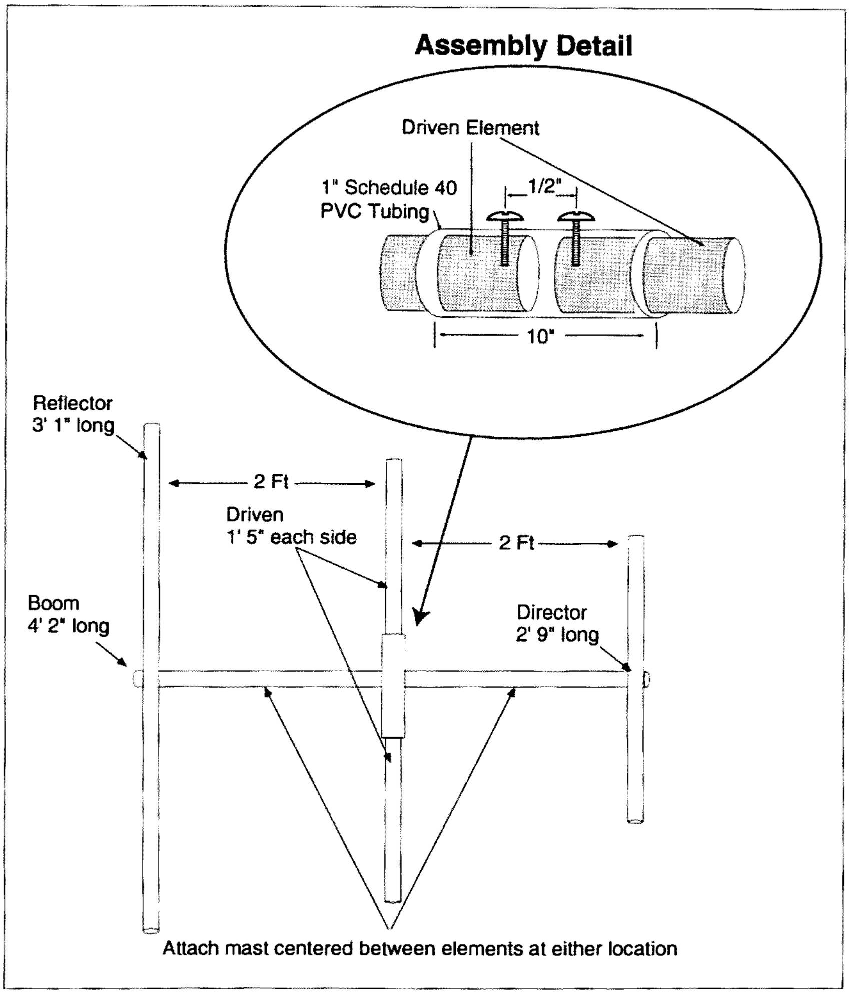

Fig. 1. Construction details.

mast is exactly center, either between the driven element and the director, or between the driven element and the reflector. Connecting a metallic mast any closer to the elements will detune the antenna causing a higher SWR. ■

NEVER SAY DIE

Continued from page 39

will expect to see you there with your entrepreneurial antenna raised. If you come across any newspaper articles you think I ought to know about, clip 'em and share them. Don't worry that someone else may have sent it too. I'd rather have five than none. I want to know what is going on in almost any new technology. I want to know about any really good ideas for helping to solve our social problems. And our health, education, and so on.

But you should be learning all you can about these things too. Long after you've forgotten a "Roseanne" episode or a ball game, your new knowledge will be with you.

My apologies. I'm probably boring you. I'm stupidly trying to change human nature. The optimist in me keeps making me forget how resistant almost everyone is to change. That's the reason I stopped doing Dianetic therapy back in 1951. I read about it in the book when it came out. It made sense, so I tried it. It worked beyond my highest expectations, so I quit my job, went to the Dianetic Research Foundation and got to be really good at it. And I cleaned out all of

Continued on page 63

Number 56 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
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In the December 1995 "Ham To Ham" column I wrote about using an IR detector diode across the mike input of a high gain audio amplifier in order to test the remote's operation — at least to determine if it's outputting pulses. Klaus Wolter N8NXF of Ann Arbor MI notes that another way to "view" IR LEDs is via a CCD television camera. Apparently, some CCD cameras have enough response in the infrared region to "see" these remotes pulsing when aimed at the camera's lens. Vidicon cameras probably won't. On the other hand, F.A. Bartlett W6OWP, and Erich Kern wrote in saying that all you really need to do is to hold the IR remote next to the tuning section of any AM broadcast receiver to "hear" the pulses. They're right, because these hand-held IR remotes put out a fair amount of digital pollution, they'll come over an AM receiver very nicely, proving that there is indeed room for too much engineering sometimes! For testing the operation of IR headphones and microphones, the IR detector/audio amp idea that I proposed is still perhaps the best way, but there are always other alternatives...which brings me to the purpose of this column; to provide a forum for your ideas, even if they may be "different." A good initial response has been received, but I still need many more tips, ideas, suggestions and better ways of doing things from all *73* readers. Don't worry about your writing skills, just include as much detail as you can and I'll put it together in the style of the column. Let's hear from you!

This month we begin a series of tips offered by Richard Measures AG6K, of Somis CA. Rich has done a tremendous amount of research into VHF parasitic oscillation suppression in amateur HF linear amplifiers, as well as fathering many practical servicing tips for some of the current amateur transceivers and accessories. With Rich's permission, I've condensed some of his best suggestions into the column's format, and over the coming months I'll include one of his tips in each column...be sure to watch for them.

One inoperative meter cure

From Richard Measures AG6K: An inoperative meter may not necessarily be bad, just in need of an overhaul. With time, humidity and the natural corrosive effects of the atmosphere, the meter used in the Heath SB-220 linear amplifier can appear to be unusable. But as in other areas of life, appearances can often be deceptive. The meter Heath used in the SB-220 is not unlike the meters used in many other pieces of ham gear, so the techniques I'll explain here aren't just for SB-220 owners by any means. Here's the reason: many meters are assembled using different types of metals for the various meter parts. These parts, which are then expected to conduct current to the meter's armature, are fastened together using machine screws at the joining points that act as the electrical conductors within the meter. As previously mentioned, time, and the effects of humidity and air pollutants, can result in electrolysis occurring at the junctions of these dissimilar metals — a perfectly natural phenomenon — but definitely not desirable within our meters! The increased resistance at these junctions can cause an intermittent or open connection at various points between its rear terminal and the meter's movement.

The problem can often be solved simply by prying off the plastic meter face cover, *carefully* removing the scale—usually held in place with two tiny screws—and then applying small dabs of conductive paint (such as GC Electronics Silver Print) to all of the dissimilar junctions that carry current to the meter's armature winding. The conductive paint can be applied with a straightened-out paper clip; it can also be thinned with ordinary acetone to facilitate penetration into any narrow areas between parts. However, be careful not to get it on anything that shouldn't conduct electricity! Also, it should be allowed to dry *thoroughly* before any reassembly takes place, since the fumes could cause problems of their own.

Be very careful when working inside one these little meters, a wrong slip could spell the end for it, but at least give it a try...chances are better than even that you'll be successful, which is a whole lot better than if you'd done nothing at all.

The silver conductive paint that Rich refers to can often be obtained from local electronic suppliers or by mail order from the larger supply houses. MCM Electronics (1-800-543-4330) stocks their catalog #21-1555 Silver Conductive Pen.

An "automatic" antenna disconnect suggestion

If you take advantage of a "master" station-power on/off switch, as do I, to disconnect all power from your station equipment to prevent "unauthorized little fingers" from turning on your ham gear, then here's an extension of that protection for your antenna circuit as well.

Disconnecting your outdoor antenna from your transceiver, when the equipment is not in use, is always a worthwhile safety precaution, in the event of a nearby lightning strike or other static buildup that might occur. It can be made "automatic" very easily, by simply installing a coil-actuated antenna relay in the path between your antenna's transmission line and the station transceiver. Coil-actuated antenna relays used to be quite common in the days of separate transmitter/receiver combinations, to switch the antenna between those two units, before the current trend of transceivers with built-in T/R (transmit/receive) switching. I've often seen them at hamfests, amid other "ancient gear," and at very reasonable prices. If the T/R relay has a 120 volt AC coil, you're all set, just put a cord and AC plug on it, and plug it into your "master" AC strip. If it has a 12 volt DC coil—as might have been used in a mobile set-up—then wire it to your station 12 volt DC power supply's output, as long as the 12 volt power supply is switched off with the "master" switch.

Make sure that the relay's contacts will handle your normal output power—most will—and clean the contacts with a thin strip of 3" x 5" index-file-card material, soaked in contact cleaner, via the relay's contact access port. The contact access port is usually covered with a removable cover plug, or in some cases, the whole cover of the relay itself may have to be removed. It's not usually a very difficult job. Don't file the contacts unless you've had lots of experience with relay maintenance though; they're usually silver (plated or solid) and you can do more harm than good by filing them—use only a paper file card, not a file! A special diamond-dust relay burnishing tool, with proper instructions, is normally used if filing is absolutely necessary.

Now cable the relay in series with your incoming antenna coax, so that your antenna system will be connected to your transceiver's output when the relay is "pulled up." Install a "shorted" coax connector into the leftover fitting, so that the antenna's transmission line is shorted when relay is relaxed—when the station AC power is "off." Finally, ground the body of the relay to a reliable earth-ground to "bleed" any static buildup safely away to the earth.

With your transceiver's antenna lead automatically disconnected, and the antenna itself shorted, you can sleep a bit more comfortably when spring thunderstorms approach. This won't completely protect your equipment from a direct hit (very little will) but it does help to protect your investment from nearby lightning hits and static build-up damage.

Dig out your mobile vertical!

From William Thim N1QVQ, of Broad Brook CT: A winterwise tip that may still have application this season for some. While you're in the process of cleaning that snow and ice off your car windows, don't forget to dig out your mobile antenna! A buildup of snow and ice around the base of your VHF or UHF mobile whip antenna can significantly raise your SWR, even to the point of forcing your transmitter to cut back on its power output. Check it with a good SWR bridge and

you'll see what I mean. Two or three inches of snow built up around the lower active portion of the antenna will often result in a noticeable SWR change.

Bill brings up a good point, though the bottom part of a 1/4-wave vertical is the high-current, low-impedance end of the antenna. Depending upon the amount of snow and ice and the operating frequency involved, the tuning of the antenna — and its losses — can be altered quite a bit. It's something we may not always think of when we're not hitting the repeater quite as well as we used to!

All-purpose probing tool from the Far East

From Herb Foster AD4UA of Melbourne FL comes this suggestion: Whenever I'm working on a piece of electronic equipment, I like to have an insulated tool in one hand to point, probe or gently tap a component or connection that might be suspect. This one is effective and, best of all, free!

Most Chinese restaurants give away bamboo chopsticks to their customers, to kind of get you into the spirit of eating out oriental style. So the next time you have the urge to take in one of these restaurants, save the chopsticks for your workbench tool inventory. When you get back home, wash them and carve one end of each into a point, a flat-blade screwdriver or even a hex-type of core-adjusting tool, and keep them handy on your bench. You can use them to poke around a crowded circuit board without fear of shorting anything out, or even use one to prop something open, if your transceiver is built into "layers" as so many are these days. And if your neck starts to itch, you can even use it to reach behind and scratch!

All you need do to obtain a supply of your own is to develop a liking for Chinese food, then take the wife and kids out for dinner. Even if you don't care to try manipulating your meal with the chopsticks, that's okay too, they'll loan you a fork and still let you keep the chopsticks...and you can't beat the fortune cookie at meal's end either!

Good idea, Herb. Bamboo keeps its shape better than many other woods, so whatever type of tip you might put on the end, chances are it will last longer than pine or other soft wood. By the way, if the fortune cookie says something like: "Avoid anything electronic today," better listen to it—you never know!

Airing taped telephone ham bulletins

From Mike Schroeder NØALJ of Rogers AR, several ideas for those of you who might be contemplating handling the airing of telephone-line originated amateur radio bulletin services for use on your local repeater's net-night get-together: I've been assigned to air the bulletin services—such as RAIN and Newsline—on our Monday night repeater net on 146.76 MHz, and I felt that I needed the best quality telephone audio possible, plus an easy-to-install record/playback system. Instead of a simple telephone inductive pick-up coil, the Radio Shack™ #43-228 does a much better job, has a built-in speaker, so it allows me to monitor what's being laid down on tape. I also use a multi-memory phone to make dialing easier and so that I can program in alternate numbers, just in case the ones I normally use are busy.

Another interesting method I've found to make quality recordings is to dial up the service you want to record on a cordless phone, then use a scanner to pick-up the radio frequency of your phone, and make a recording from the external speaker jack of that scanner.

As far as playback of the tapes over-the-air on net-night, if you want something simple, you might try an inductive pick-up coil backwards—such as the RS #44-533—if you have a dynamic or magnetic type of mike on your 2-meter transceiver. In other words, feed the tape machine's earphone/speaker audio output into the inductive pickup, and place the coil over your mike. This won't work on the new electret-condenser type microphones, but in that case, the easy to build interface box shown in Fig. 1 can be used.

Using an inexpensive digital timer (such as the Radio Shack

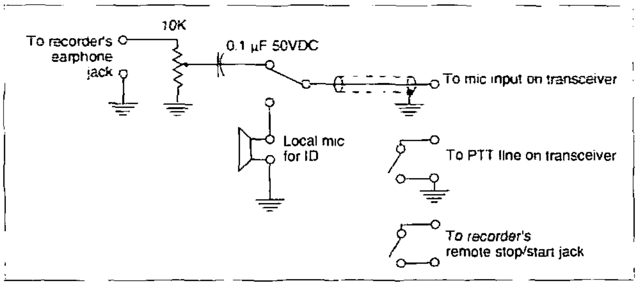


Fig. 1. NØALJ's Net Bulletin recorder controller.

#63-884) that's started when the tape is started will give you an elapsed time indicator, so that station IDs can be inserted at the proper times. The tape can be paused for the ID by simply having an SPST toggle switch on a cord, plugged into the tape machine's remote stop/start jack. If fact, all of these functions can be integrated into the one central control box (see Fig. 1) - recorder interface with its mike/tape switch, remote tape stop/start switch, transmitter PTT switch and a small digital timer—all equipped with the correct plugs to mate with your specific equipment. On net night then, it's almost an automatic few-second setup to get things going correctly, instead of a Murphy-prone chore!

Good tips, Mike. Building everything inside a metal box and using shielded cabling will help to reduce the possibility of RFI problems during the on-the-air phase of the operation. If you still have problems, try putting small ferrite beads on all the input/output leads, and/or .001 µF disc capacitors from the offending lead to ground. At 2 meters, sometimes a lead will inadvertently end up being either 19" or 38" long, acting as a resonant pick-up antenna for your own signal! Check for that too.

For your files

From Joel Masur AA5YA of DeLand FL: a few good suggestions for working aluminum sheet stock. What follows is an idea that you might want to try if you've ever had difficulty "squaring up" aluminum sheet stock for panels, etc. Try to locate an old time lead body file, mine is a New Britain #285; an auto parts store or older auto body shop might be a good place to start. Mount it on a husky wooden handle, so that it resembles a flattened wooden block plane. The half-moon shaped teeth in a file like this will eat-away at the soft aluminum very nicely, without the normal tooth-clog problem we're all familiar with in finer-tooth files.

Additionally, you might try Forstner wooden bit and power auger files for getting into the corners of the square or rectangular cutouts needed for snap-in switches, etc. The ones I have are 7" long, 1/8" thick and 7/16" at the widest part. They're shaped something like a diamond that's been stretched-out to the 7" length but with a 1/4" wide by 1-1/2" long connection strip. One end of it has teeth on the flat side and none on the edges; the other end is exactly opposite...no teeth on the flat side but teeth on the edges.

Now that you have the tools, what about the stock? Free is always nice, and here's an approach you might want to try. Make friends with the public works department foreman in your town and see if he has any salvaged road signs that he'd just as soon get rid of. They can make great electronics panels if they're not badly damaged. Leave any decals on until you've cut and finished the material for the project you're working on for protection of the under-finish.

Octagonal "stop" signs make nice 2 meter ground planes for a mag-mount antenna, providing they're made of steel. Other steel traffic control signs can be used for the same purpose if they're sized about right (roughly 40" by 40").

If the public works foreman has any outdated aluminum traffic control counter boxes taking up space, latch onto them; they're the boxes you'll sometimes see placed at the side of the road, chained to a tree, with a long rubber tube coming out of them and

onto the roadway. They count the number of cars using a particular road over a period of a few days, but the discarded ones also make great boxes for outdoor tuning units, power supplies, or even an entire mountain-topping QRP station! The air hose hole can serve as an input/output access. Just be sure to go through the right channels when helping them to get rid of their obsolete signs and boxes; you don't want to be operating portable from the police department's holding cell!

If the auto body shops you check with don't have the files that Joel is referring to, ask them where they purchase their supplies and try directly. You might also check with the W.W. Grainger outlet nearest you, as well as any other contractors' supply houses in your area.

Quick tip for testing transistors

From Peter Albright AA2AD of Lakewood NY: This suggestion for quickly testing out-of-circuit transistors. Here's an easy method of using a multimeter's "ohms" scale to reliably test transistors. The very few minor limitations are as follows:

1. It works best with an analog (needle style), rather than a digital meter.

2. It should only be relied upon when the transistor has been removed from circuit.

3. The test works on bipolar transistors only, not on FETs, SCRs, etc.

4. It doesn't yield any information on a transistor's gain or "beta."

The limitations, in my opinion, are more than offset by these advantages:

1. The test is fast and requires no specialized equipment.

2. You will get no false "defective" results.

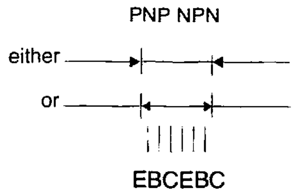
3. The only false "good" result might be from a thermally-sensitive transistor, i.e. if the transistor only shows a defect under the stress of heat during actual operation.

4. It can often be used as a first step in identifying lead configuration.

Here's the theory: There are two types of semiconductor material, "P" type and "N" type. A junction diode, such as a silicon power diode, consists of one layer of "P" material mated against one layer of "N" material, and this junction conducts current in one direction only.

Bipolar transistors, on the other hand, always consist of three alternating layers of these three materials — either "PNP" or "NPN" — with a wire connected to each of those three layers. To an ohmmeter, which has only two test leads, the transistor looks like two diodes, either back-to-back, or face-to-face. This concept alone takes a lot of the mystery out of transistors.

Regardless of which type of transistor is being tested, the wire to the center layer is the base, while the two outside layers are the emitter and the collector. So the configurations, when drawn as diodes, are:



In practice, it's really easy to test a diode with an ohmmeter. Set the meter to the R times 1K range. Measure the resistance, first in one direction and then in the other, by reversing the ohmmeter's test probes. Silicon diodes will measure virtually infinite resistance when the positive probe is connected to the diode's cathode (usually marked by a band). Conversely, they'll measure some continuity when the positive probe is connected to the anode. Note that not all multimeters apply a positive voltage to the red meter lead; you'll have to test your own meter with a known good diode first, then mark the meter as to which test lead is actually outputting a positive voltage. It need only be done once. Germanium and selenium diodes on the other hand, which are point-contact diodes, rather than junction diodes, may show some continuity in both directions, but the amount of continuity in one direction, will always be much higher than the other, if the device is good.

If you're still with me, you've probably already figured out how to test a transistor with an ohmmeter, thinking of it in terms of two diodes. Here's the procedure, in step-by-step format:

1. ALWAYS turn the equipment off, unplug it or remove the battery, and discharge any filter capacitors — usually identified as the physically larger capacitors.

2. Remove the suspected bad transistor by carefully unsoldering it from the circuit.

3. Set your ohmmeter to the R times 1K scale or higher. This limits the testing current, protecting the transistor from damage. Don't use the very low ranges on your meter for these tests.

4. Connect either lead of your ohmmeter to what you believe to be the base of the transistor.

5. Measure the resistance to each of the other two leads. The reading should be the same for both leads: either nearly infinite (open) or finite (some continuity).

6. Now switch probes: that is, connect the other probe tip to the base.

7. With the probes now reversed, measure the resistance to each of the leads once again.

The reading should again be the same for both leads.

a.) If your result the first time around was "infinite," then you should now see some continuity between base and emitter as well as between base and collector.

b.) If your first round results showed "continuity," then your measurement now should be nearly "infinite" resistance (open) to both emitter and collector.

8. If you get some result other than these, then assume that the transistor is defective.

Notes:

a.) As with germanium diodes, germanium transistors may show some continuity in both directions, but there will be a distinct difference in the resistance when you reverse the probes. You probably won't find many germanium transistors in equipment less than twenty years old, but you will find germanium diodes in more recent gear.

b.) If the transistor is bolted to a metal heat sink and has only two leads coming out of it, then the bolt tab or threaded stud will be the third connection. Bolt tabs and studs are always the collector.

c.) If you don't know the lead configuration of a device, you can use this technique, along with trial and error, to at least identify the base lead, provided the device isn't defective.

If you REALLY understand this technique, it can save a lot of time and trouble, as well as taking some of the mystery out of transistors and solid-state electronic troubleshooting in general.

Peter's suggestion is a good one to remember: it's a good "quick test." It might pay to clip this out and post it near your workbench, so that it's handy the next time you need it. It would also pay to practice on a few good transistors, now, just to get a "feel" for what he's saying and to overcome any reluctance you might feel toward solid-state troubleshooting. Hands-on learning is always worthwhile: after all, you can't do much harm...and it's good hand-to-eye coordination practice!

TNX to those who have contributed to this month's column:

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Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of 73 , and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic

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A Simple One-Hour
Continued from page 40

The few components can be mounted on a terminal strip. R1 is best attached to either the rear of the meter case or the interior of the enclosure, using epoxy, superglue or hot glue.

Calibration

Look at your meter scale. With luck there will be four main divisions. If not, carefully take the meter apart and divide the meter scale into four equal, 10-volt divisions, using a fine tip felt pen. Mark these points 90, 100, 110, 120, 130, starting at the zero end of the scale as follows: The space between 90 and 100 is one division; between 100 and 110 is division two; between 110 and 120 is the third division; and the final division is between 120 and 130 at full scale. Reassemble the meter and mount it in its enclosure.

If you are unfamiliar with disassembling meters, please see my article, "Use Those Surplus Meters," *73 Amateur Radio Today*, January 1992, page 42.

With your meter scale properly calibrated and all parts mounted in the enclosure, adjust R1 to maximum resistance. Using an accurate AC meter—a digital multimeter is preferred for accuracy, but a V-O-M can be used—measure the AC voltage at the nearest outlet, and note this value.

Plug in the Line Voltage Monitor. Being very careful not to touch any points carrying voltage, adjust R1 so the meter indicates the same voltage you measured previously. This completes calibration.

Operation is automatic. When this instrument is plugged into a live 117 VAC outlet it will continually monitor the level of voltage supplied by the power company.

Notes

Be sure the meter you use has a moving coil (D'Arsonval) movement. Do not use an iron vane meter. If you can't tell the difference at a glance, a good rule of thumb is: If it looks expensive, it probably is a D'Arsonval meter. If it is round or square and has a cheap-looking black painted metal case held together with bent metal tabs, it is probably an iron vane meter.

There are similar-looking line voltage meters commercially available costing about $20. Some of these appear to use an iron vane meter. You can build a better monitor for a lot less money.

A major disadvantage of using an iron vane meter to which a voltage is applied continuously is that they lose accuracy as the movement becomes magnetized. You'll find that, if you unplug one after a year in use, the needle will not return to the left end of the scale. Instead, it will indicate some level of voltage even though none is being applied.

An excellent and inexpensive source of surplus name-brand meters with D'Arsonval movements is Fair Radio Sales, Box 1105, Lima, OH 45802. A selection of five meters (their choice, not yours), Catalog No. 47-84, costs $10. Mostly basic 0-1-mA movements will be in each selection. Usually there will be one, possibly two meters with 100-µA movements. Some may have internal shunts, multiplier resistors, or rectifiers, but these are easy to eliminate, leaving you with the desired basic meter movement. This gets you your meter for only $2, and you still have four more nice meters for future projects!

Johnson Matchbox
Continued from page 47

Further Reading

1. Witt, F. (AI1H), "How to Evaluate Your Antenna Tuner- Part 2," *QST* May 1995
2. Magnusson, John E. (W0AGD), "How's Your Antenna," *CQ* January 1962, p. 27. Picture is of the kilowatt version of the Johnson Matchbox.
3. Marriner, E. (W6XM), "Another Antenna Tuner," *Ham Radio*, May 1983. Describes building a dual differential variable capacitor. Shows construction of one-half of the Matchbox circuit for use with a balun or unbalanced loads.

References:

1. Mitchell, J.D. (K4IHV), "MatchBox Plus Two," *Ham Radio*, July 1979. Describes a modification of the Johnson Matchbox.
2. Maxwell, M.W. (W2DU), "Reflections," The American Radio League, 1990, p. 13-14. Comments on the theory of operation of the Matchbox circuit.

Debunking Some Myths
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HAM TO HAM
Continued from page 58

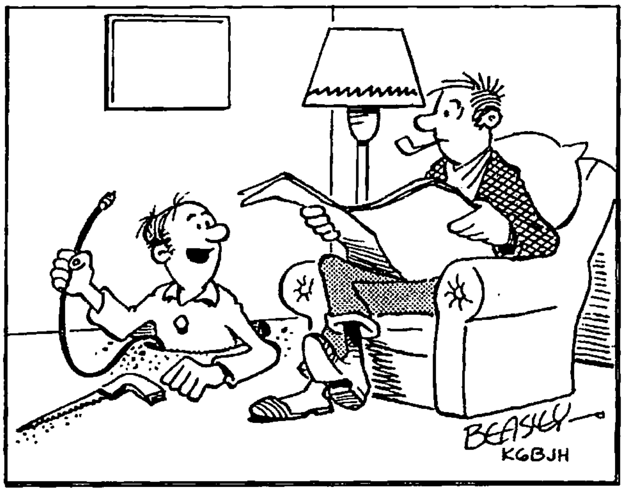
item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or 73 for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to 73 's "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by 73 . We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to 73 .

Calling Young Hams!

Carole Perry WB2MGP is looking for youngsters under the age of 18 who are enthusiastic about amateur radio to contact her about appearing at the DAYTON 96 HAMVENTION this year. Kids should have good speaking skills and be at ease in front of an audience.

Please write or phone at PO Box 131646, Staten Island NY 10313-0006; (718) 983-1416 **ASAP**. Have some fun, network with other hams, and wouldn't this look good on your college applicationss?



***Toon 2:** Hi, I'm the ham from downstairs—mind if I run my coax through here to the roof?*

Continued on page 81

CRRR'S CORNER

Joseph J. Carr K4IPV
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A Little Hank of Wire

One of the problems in getting on the air, especially if you are short of cash, is the little matter of the antenna. One can spend anywhere from $29.95 to $5995.00 for an HF antenna for the ham bands, especially if one wants multi-band operation. In my early years of hamming I was perpetually broke, so learned first hand how to do things on the cheap. A couple hundred feet of wire and coaxial cable is not terribly expensive, but can make a dandy antenna.

Most of us are familiar with the half wavelength dipole, but it isn't the be-all and end-all of HF wire antennas. One of my favorites, and one of the earliest antennas that I used, was the Windom. The first Windom I saw was used by my mentor, the late Mac Parker W4II, although he wasn't enamored of it. We also had a Windom antenna on the roof of the Industrial Arts building of Washington-Lee High School (Arlington, VA) where K4BGA was the club call sign...and it worked a lot better.

The Windom antenna (Fig. 1) has been popular since the 1920s. Although Loren Windom is credited with the design, there were actually a number of contributors. Coworkers with Windom at the University of Illinois were John Byrne, E.F. Brooke, and W.L. Everett, and they are properly co-credited. The designation of Windom as the inventor was probably due to the publication of the idea (credited to Windom) in the July 1926 issue of *QST*. Additional (later) contributions were rendered by G2BI and GM11AA (Jim MacIntosh). We will continue the tradition of crediting Loren Windom, with the understanding that others also contributed to this antenna design.

The Windom is a roughly half-wavelength antenna that will also work on even harmonics of the fundamental frequency. The basic premise is that the antenna radiation resistance varies from about 50W, to about 5,000 W, depending upon the selected feedpoint. When fed in the exact center, a current node, the feedpoint impedance will be 50 W; similarly, end-feeding the antenna finds a feedpoint impedance of about 5,000 W. In Fig. 1 the feedpoint is tapped away from the center at a point that is about one-third (0.37L) the way from one end, at a point where the impedance is about 600 W.

The feedline for the basic Windom of Fig. 1 is an insulated length of wire. Of course, the size of the wire depends on the power level, but I suspect that #14 insulated stranded wire will do for most people who run less than 200 watts of power. Indeed, I wouldn't like to use a Windom at high power levels because of the "RF in the shack" problem.

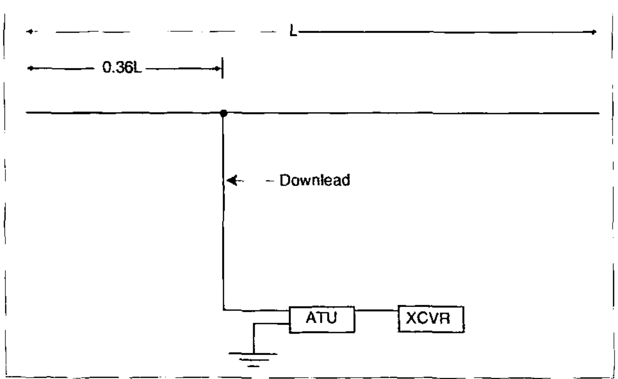

Fig. 1. The basic Windom antenna.

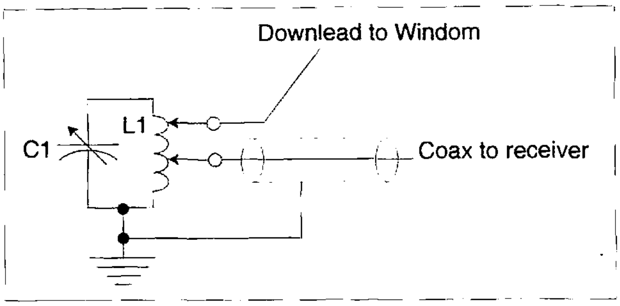

Fig. 2. Antenna tuning unit for Windom.

The Windom antenna works well....but with some serious caveats. For example, the antenna has a tendency to put "RF in the shack" because it is voltage-fed. Second, there is some radiation loss from the feedline. Finally, the antenna works poorly on add harmonics of the fundamental frequency.

The antenna tuning unit can be either a parallel resonant, link-coupled, LC tank circuit (see Fig. 2); or a reversed pi-network. In the case of the Windom, the pi-network is turned around backwards from the usual configuration: C1 is at the low impedance end of the network, so it is larger than C2. Design a pi-network to match 50 = on the transmitter end, and 600 = on the antenna end.

Note that a good ground should be used with this antenna (note the ground connection at the output of the antenna tuning unit). This means (for most people) an eight-foot ground rod, or a system of radials.

A reasonable compromise Windom, that reduces feedline radiation losses, is shown in Fig. 3. In this antenna a 4:1 balun transformer is placed at the feedpoint, and this in turn is connected to 75 W coaxial transmission line to the transmitter. A transmatch, or similar antenna tuner, is then connected between the transmitter and the transmission line.

An Old Myth Revived?

There are a number of myths that are widely held among radio communications hobbyists...and amateur radio is no less infested with some of these myths than others (CB, for example). Twenty-five years ago I worked in a CB shop in Virginia, and we kept hearing one old saw over and over again: you can cut your coax to reduce the VSWR to 1 (actually, they meant "1:1" but routinely called it 1). Hordes of CBers have cut the coax and watched the VSWR reduce to 1:1, so they cannot be talked out of the error. What actually happens in that case is a measurement difficulty that makes it appear to be true.

Of course, Hams are superior to CBers so don't believe that error, right? I'd like to think so; but having been in both the CB and the amateur worlds, and "Elmered" more than a few CBers studying for amateur licenses, I have to admit that at least as many amateurs believe the "cut-the-coax" error as CBers (sorry, fellows, but that's my observation). Recently, a couple questions on this topic arrived in my E-mail box (carrjj@aol.com).

The only really proper way to reduce the VSWR to 1:1, in my opinion, is to tune the antenna to resonance. For a center-fed half wavelength dipole, or a bottom-fed quarter wavelength vertical, the proper way to resonate the antenna is to adjust its length to the correct point. The formulas in the books and magazines only give approximate lengths...the real length is found from experimentation on the particular antenna after it is installed. Even commercial antennas are adjusted this way. On certain CB mobile antennas, for example, this trick is done by raising (or lowering) the radiator while watching the VSWR meter. On amateur antennas similar tuning procedures are used.

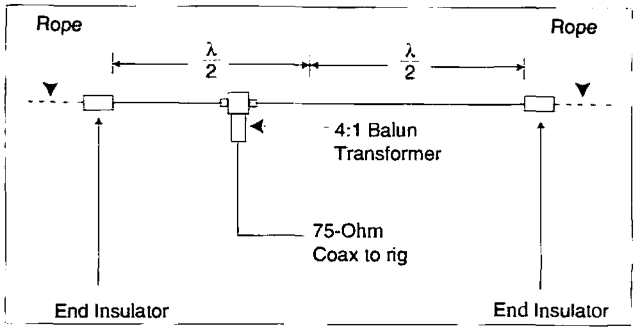

Fig. 3. 4:1 Balun

Another ploy used by amateurs (including myself) is to connect an antenna matching unit (tuner) at the output of the transmitter. For my Kenwood TS-430, I use either a Heath SA-2060A or an MFJ Differential Tuner to "tune-out" the VSWR presented by my Hustler 4BTV and 75 feet of coax. But I don't even pretend to be tuning the antenna. The TS-430 is a solid-state rig, and the finals are, therefore, not terribly tolerant of VSWR, and will shut down with a high VSWR. The purpose of the antenna tuner is to reduce the VSWR seen by the transmitter...and to heck with the actual antenna mismatch on the roof. The tuner also serves to reduce harmonics further, thereby helping to prevent TVI. The best form of antenna tuner is one that both reduces the VSWR (for the benefit of the transmitter), and also resonates to the antenna frequency, preventing harmonics from getting out (a dirty little secret is that many "line flattener" ATUs are actually variable high-pass filters, and must be used with a low-pass filter ahead of them if spurious signals are to be kept at home.

Clarification

I received a number of queries in my America On-line mail box about the "Quick 'n' Dirty Twin-Lead Antenna" discussed in this column a couple months ago. I still get feedback on that antenna, and have made at least one correction on it, but the questions continue, so here goes again. The two conductors at the far end of the twin-lead are shorted together. If you check the continuity of this antenna with an ohmmeter at the feedpoint end you will read a short circuit (or only a few ohms of DC resistance, depending on length). The antenna is not left open, or will not work.

Another requirement not made all that clear in my article is the fact that this is basically a form of Marconi antenna, so needs a very good ground to work effectively. As mentioned above, this means that you should get an eight-foot copper-clad steel ground rod, or lay in a system of radials. I should have mentioned that originally, but somehow it slipped my mind until a couple of experienced, sharp-eyed readers spotted the error. Sorry.

Connections...

I welcome your comments and questions, as well as ideas for this column. My snail mail address is P.O. Box 1099, Falls Church VA 22041, and my Internet E-mail address is carrjj@aol.com. 73

QRP

Number 62 on your Feedback card

Low Power Operation

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Been there? Done it? Try life in the QRP lane.

There seems to be an increase in hams (re)discovering low power operation. Called QRP, it's an interesting way to get back into ham radio after you've done it all!

Several years ago, we looked at some of the frequently asked questions about QRP. There seemed to be a pattern, so I recently went through piles of letters and picked out some others. Here is an updated version with even more frequently asked questions answered—in no particular order. Enjoy!

What are the most popular QRP bands?

There really is no one band more popular than others. You'll find QRP operation from DC to light, but most QRP activity may be found on the 40-meter band around 7.040 MHz. Also check 7.035 MHz as well as 7.060 MHz for QRP operators. You'll find many of the European stations lurking around 7.030 to 7.035 MHz. Start with 28.060 (although it's not carved in stone) as the 10-meter QRP calling frequency. The 30-meter band is a QRPers delight! Try 10.106 and up for low power signals. There're lots of HF packet on the very high end of 30 meters. If you have a QRP rig that will operate SSB, give HF packet a try.

Let's not forget about the 20 meter band either. This is by far the most popular ham band when it comes to working DX. Low power operation used to be located around 14.060 MHz, but alas, other forms of digital signals have been moving down, overtaking the QRP calling frequency. Check the entire band for QRP operators; they're everywhere on 20. Fifteen meters is also quite popular, but with the current lack of sun spots, activity is a bit sparse. Always check the band, however, at or near 21.040-21.065 for QRP operators.

"I'm not 'into' CW. Can I still operate QRP?"

CW is by far the most popular mode of use for QRP operation, partly because CW transmitters are easier to build than SSB rigs. With CW, you get more bang for the watt too. But QRP is not only CW; it's any mode you want to use, be it FM or SSTV. Remember QRP means low power—not CW only.

There's been an increase in activity on 6 meters due to the influx of multiband mobile rigs. Don't let it throw you. A inexpensive 6 meter transverter is now available from TenTec at a very reasonable price.

The #1 absolute *must* on 6m is a good antenna. A wire between two bushes just won't do. A chopped up and converted CB beam antenna makes an ideal and inexpensive beam for six meters.

"Do I need to change rigs or equipment to operate QRP?"

Of course not! Most of today's rigs can be easily turned down from a front panel control. You'll end up with low transmitter efficiency, but you won't have to spend a dime either. The Index Lab rig covers all ham bands, plus a general coverage receiver. The rig operates on SSB and CW; it will set you back $700.

"How about antennas? All I have is a simple dipole."

No matter what the power level in an amateur radio station, the better the antenna, the better your signal will get out. Use a good grade of feedline and get the antenna as high as possible.

"I enjoy a good contest now and then. How can I compete with other stations if I run 2 watts?"

Most of the bigger contests such as the CQ World Wide DX contest, Sweepstakes and even Field Day have special low power sections. You only compete against others within the same power class.

"The bands are dead, as is my final; now what do I do?"

Surf the net! There are 700+ members on the Internet QRP-l group. To subscribe to the newsgroup do the following from your web browser or mailer: Send an E-mail to listserv@lehigh.edu in the body of the message type SUBSCRIBE QRP-L

Then follow with your name and call.

Yup! It's that time again!

The Dayton HamVention will be May 17-19 this year, so mark your calendars! The QRP ARCI will be hosting a weekend-long QRP session at the Day's Inn at the South Dayton Mall. Things begin Thursday and wind down Sunday afternoon. As usual, the QRP ARCI has several blocks of rooms reserved. If you want to stay with us, call Myron Koyle at (216) 477-5717 to reserve your room. If you were with us last year, and you filled out one of the yellow 1996 application forms, you're all set. However, if there should be a change in your plans, be sure to get in touch with Myron to update his files.

The QRP ARCI will also host several talks during the HamVention. Saturday night will be our awards banquet. There is always something to see or do at the hospitality suite before and after the banquet. Along with the QRP ARCI in Dayton will be the Michigan QRP club, the NorCal club, the G-QRP club and a boatful of others.

There are all kinds of things to do at Dayton for the QRP-challenged! Many of the companies that specialize in QRP equipment showcase their newest creations at Dayton. Dick GØBPS from Kanga always brings the cutest gizmos from G-land. So, if you want a whole weekend of QRP, then set aside a few days in May. Remember, the date has been changed! The Dayton HamVention is now the week ending May 19, 1996.

Bring your stories of the rarest DX—any time you're more than 25 miles from home, you're an expert! Bring a carrying pouch, so you can lug home your very own DX-100! Bring lots of money, for all those things you really don't need! And bring your wife; she'll keep you in line. Hope to see you there! 73

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really good at it. And I cleaned out all of the crap in my mind that had been defeating me. That's when I started reading and learning. Not long after that I started my first entrepreneurial businesses and made my first million.

But what I found was that I had the key to helping anyone get rid of the mental baggage that was making them sick and keeping them from being successful. Only I also found that almost no one had any desire to change. I was able to help people get out of insane asylums and lead productive, happy lives. But most people in asylums fought change. So I said to hell with it and started manufacturing loudspeakers.

At these science conferences I meet lots of people with great ideas, but without the gumption to capitalize on them. Steve Jobs would have gone nowhere without Mike Markkula, who's the guy who really made Apple. If Jobs hadn't screwed things up many of us would be using Apple IIt computers zipping along at 250 MHz instead of IBM clones. Or even Macs. Unless you have a memory of my editorials you probably haven't heard of the 65816 and 65832 chips Wozniak wanted to use to update the IIc. And that was just the beginning.

Start reading some of the books I've been recommending. Start meeting me at some conferences. Hey, buy me a lunch! Or maybe, if that's too much trouble, get your hamfest chairman to bribe me to take off a couple days and give a talk so I can whip some life into the turkeys around you. I might be able to get them to lose some of that lard hanging over their belts and clouding their brains. I might get them to actually think. Maybe not. Can I get them to start reading? I keep asking you to let me know of any book "I'm crazy if I don't read." I don't want to hear about good books, interesting books, or fun books. I want to hear about truly great books...and don't forget the address of the publisher so I can get a review copy. You already know I'm thrifty (aka cheap). If you don't, then you haven't been enjoying my travel books. I suppose I should put all them together into one big book the way Michael Crichton did. Hey, I've got to add his "Travels" to my list of must-read books. I'd forgotten about it!

If I can fit it into my schedule I'll come and talk at any hamfest where you can get at least 300 people together. And then pay for me and Sherry to make the trip, plus help me sell some of my books and magazines? Get me there a day early and arrange for me to be on the local radio and TV news and interview shows to help build attendance for the hamfest. I talk about so many things that you'll have to buy a tape of my talk to remember everything. I usually get into health, longevity, how to make money, hamming, new technologies, education, and so on.

This is a hobby!

A whole sheaf of papers landed on my desk describing what appears to be a three year total waste of a whole lot of people's time and money battling over a Southern California repeater. The bottom line is that yes, we sure do have some remarkably stupid jerks with ham tickets and no practical way of getting rid of them. If only it were as easy

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Number 64 on your Feedback card

Above & Beyond

The Care and Feeding of a VHF-to-Microwave Enthusiast

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San Diego CA 92119

Who and what is the San Diego Microwave Group? Do you have a newsletter? Does your group charge membership dues? How many members interested in microwave do you have? How did you get started in microwave operations and how do you keep a group together? What is it like to start a group-interest forum based on microwave and related subjects? How do you manage to keep interest going in today's ever-changing world? What type of microwave equipment does your group use?

Well, these and a few other questions are the most often asked of the San Diego Microwave Group. First, ours is not the only group involved with microwave. There are many other groups, all of which promote microwave communications, interest in build-it-yourself, and operation on our VHF through microwave bands. The San Bernardino Microwave Society, the North Texas Microwave Society, and the Pack Rats in the Northeast are just a few.

All of these fine groups act in concert, and depend on amateurs' willingness to disseminate individual and group technical knowledge to other amateurs through newsletters and technical sessions. It is this spirit of cooperation and sharing that has promoted a new interest in microwave activity and a resurgence of home microwave construction projects. It is in this arena that I am able to explore my most rewarding amateur activities, home brewing or converting a surplus item to a usable device for our amateur microwave bands.

I'd like to describe the San Diego Microwave Group's position. We try to put our best efforts forward in methods and technologies for new microwave construction projects. Part of our goal is to explore new bands and populate them, and examine the different propagation effects on that band, be it microwave or laser technologies. Sometimes it seems that we expend a lot of effort to jump up to a new frequency. I assure you that it is difficult trying to locate new, usable pieces of microwave equipment. Quite possibly we do it for the "rush" we get locating and constructing these devices.

It might seem comical to some, but we enjoy the chase and construction aspects of this realm of frequencies. Our group has modified many different commercial satellite microwave devices, converting them for use on amateur bands. The components can be hard to locate, but once built into a usable system can provide a platform for state-of-the-art systems and testing different forms of propagation. It's kind of like operation in a new frontier where you can't just dash out to the store and buy the equipment. Almost all of the equipment required is home-constructed. The first axiom: You must have a very good relationship with your soldering iron, or at least be prepared to become attached to it.

If radio communication and operation is your thing, why go to remote hilltops and other locations when the same communication could be done easily on other, lower-frequency bands? This seems to be the biggest question presented to our respective microwave groups. See if this makes sense to you. You can *catch* fish with a net and be very successful, but if you enjoy *fishing*, you might want to try the cutting edge of the sport — fly-fishing. It might not be as successful as to quantity, but proficiency with your method means you make up the difference in personal satisfaction.

The pleasure gained from fly-fishing can be compared with the same feeling of accomplishment and success that has re-inspired and invigorated amateur radio construction. As for my personal microwave communications experience, it's like going back to my early years of excitement and enjoyment fabricating much simpler tube-type equipment scrounged from old (1960s) TV receivers, etc. Just as it was in the beginning (sounds like a fairy tale) the initial excitement of constructing a simple crystal radio in the 1950s is renewed through microwave construction in the 1990s.

The San Diego Microwave Group was formed by interested radio amateurs to promote and develop circuitry and equipment using microwave frequencies and various modes to communicate with other amateurs. We do not publish a newsletter or charge dues, although some day we might have a newsletter when we can get the energy off the workbench and onto the keyboard. Until that time, this column has been (and will continue to be) the sounding board for interesting new projects that have polished our abilities and operational skills. We have tried new methods of discovery and learned a lot in the school of hard knocks.

Hopefully we have smoothed out some different applications and equipment to improve our circuitry, making operation easier and more enjoyable. If I couldn't draw on the experience and resources of our group, using their excellent technical abilities, this column would be diminished. The constant sharing of initiative modifications, and technical upgrading of various microwave systems enables me to present them to you; it's what makes our group click.

Information is distributed to our group members via two methods: one is our monthly meeting on every third Monday at the home of N6IZW. It provides eyeball QSOs along with equipment adjustments and tests. Our meetings are informal gatherings around a table of new widgets to be described or tested at the beginning of the meeting. Later we adjourn to a group discussion.

The second way to keep our group together and distribute information is to have an informal roundtable on the 2 meter Palomar repeater at 9 PM every Monday evening except the 3rd Monday of each month. (The Palomar repeater is located in Southern California and operates on 146.73 MHz, 600 kHz down. It is located on Palomar Mountain near the Hale or Mt. Palomar 200 inch telescope.) Discussions on these Monday nights range the gauntlet from simple to very technical operations. The topics are usually left up to the individuals checking in to the net—questions or information on new equipment or apparatus to share.

That's the basic premise of the "nets" that our group and similar other groups of amateurs have started. The primary function of a "net" is to pull in interested amateurs from all aspects of the hobby to inform them on VHF and above related topics, and to pull them into our world if they are interested. As with any venture, be it business or otherwise, if you don't advertise you don't get exposure. Exposure—that's all it takes to set up your own Microwave Group.

The San Diego Microwave Group was started through the efforts of Red Truax W6BLK. Red was a long standing member in the San Bernardino Microwave Society and wanted to start a similar organization here in San Diego, because of the 80 or so miles separating eye-to-eye discussions, and the effort required to attend meetings in San Bernardino. In the very early days Red had some stationery printed with the SDMG's logo on it and had several plastic ID badges made with the same logo and our call signs. Kerry N6IZW and I were among the small original group.

The badges were a gift from Red for the SDMG's first members. I remember well going to swap meets with Kerry and making short distance Gunnplexer 10 GHz contacts from two different parking spots at a drive-in theater where the swap fest was held. The operation at the swap meet was our "net" and it assembled a large group of interested amateurs who did not know, at that time, how to contact others who had a similar

interest. The "net" or show-and-tell at the swap meets was very successful as we soon had about 20 interested amateurs, all with similar goals and construction interests, microwave. Wide band FM operation on 10 GHz was in full swing.

Red participated in many of these early contact sessions and attended many meetings, showing a great heart and compassion for construction, and diving into microwave circuitry. I'm grateful to Red, who nudged me into this field. Unfortunately, Red's health was not good and he became a silent key, but not before he saw the beginnings of our group flourish. He envisioned and urged us into this realm and we do not forget him. We still have the badges he presented to us in those early days to remind us of his influence.

Why did we select 10 GHz to function with as a primary frequency and not some lower frequency? Well, when your current equipment was up to 450 MHz, at that time the jump to 10 GHz was quite a leap. However it was not made without lots of thought. We envisioned that 1296 MHz was similar in operation to 450 MHz in practice. The equipment for 2304 MHz, 3456 MHz and 5760 MHz was hard to obtain; surplus Gunn oscillators were being dumped on the market for 10 GHz. We just took advantage of the availability of the 10 GHz Gunn Burglar alarms and garage door openers that were starting to appear on the swap meet circuit in large numbers. We used the inexpensive materials and developed it into a wide band FM transceiver operating full duplex.

Power output was in the 10 milliwatt range, frequency was a little drifty and difficult to set. Waveguide absorption wavemeters allowed frequency to be set on a field day hilltop to ± 3 MHz accuracy. Sure it was a fishing expedition, but an enjoyable one. The equipment was inexpensive and the outdoor activity was quite amazing, making contacts over 100 miles in distance with this flea power on microwave. The receiver, by the way, was a single 1N23 type diode in the transmitting waveguide, feeding a 30 MHz pre amp and IF single chip FM receiver. This chip receiver was sort of like Dick Tracy's wrist watch radio; a receiver in a single 16 pin plastic chip TDA-7000 device from Signetics.

There have been lots of developments and relevant circuitry changes since our beginnings in the late 1970s when we used wide band FM equipment exclusively; the TDA-7000 WBFM single chip receivers. We still have this equipment today. However it is not used, but is ready for action if there is a need. Generally we take it out for those who still operate WBFM in the ARRL 10 GHz contests held each year in September and October. While WBFM use is declining, it is still a beginner's low cost method to get on microwave operation. Our group still has this equipment ready for use, in keeping with our goal of helping anyone make a contact, whatever mode they might have to use, be it WBFM, SSB or CW. After all, a new mode and equipment for microwave operation is not the easiest to get running right for your first contact. Mastery takes time and experience.

The equipment that The San Diego Microwave Group uses today is a far cry from our modest beginnings and WBFM. I stress that point because we can get so wrapped up with our latest and greatest and forget that there are amateurs who have not developed a system similar to ours. If we become too narrowly focused we will lose sight of newcomers' interest levels; newcomers who can become just as involved as we are now, but first must learn some of the steps we've taken. In other words, don't leave someone behind in the dust. If you are going to form an interest group, be prepared to work at *many* levels of interest. Offer help and answer questions for all who show interest. After all, the primary goal is to have lots of fun with amateur radio.

I thought I would close with a brief description of our latest 10 GHz microwave transceiver club project. As far as I am concerned you can't do better, considering that this unit was converted from surplus material much like our earlier units that were capable of SSB / CW / narrow band FM operation. Our older units were a series of single boards connected with coax, and consisted of about 10 individual modules. The new unit is a single main module with an external synthesizer and power supply. The complete main PC board is 4" by 5 1/2" and less than 1" high. Quite a remarkable system.

The main board uses Gaas FETs for both receive and transmit amplifiers and has two onboard RF mixers, along with a local oscillator (LO) multiplier and LO distribution amplifiers; it's very sophisticated for amateur operation. Comparing the sensitivity and operational condition of this unit to WBFM is like comparing a skateboard (WBFM) to a Lincoln (SSB). With SSB systems our frequency is synthesizer controlled referenced to a stable quality 10 MHz TCXO time base. We have come to expect frequency errors on 10 GHz to be less than our SSB bandwidths of 2 to 3 kHz. In many instances frequency accuracy is in the hundreds of Hz.

This high accuracy frequency removes uncertainty and really helps make contacts. It's almost like 2 meter operation. Experimentation with bounce and reflection paths vs. direct path contacts are a joy to observe with their Doppler and other "special effects" that change the microwave signal. Home brewing, surplus conversion and other factors add enjoyment to our hobby that you can't get ready-made out of any box.

The difference in these new designs, as with any new circuitry, is that the old system must be either rebuilt or discarded for the newer mode of operation. In this case WBFM equipment is not usable or compatible with SSB operation and must exist by itself. The SSB equipment must be constructed from the ground floor and the real penalty is the added cost for circuitry improvements. Did we find that going to SSB was worth it? You bet! I believe if you are bitten by this microwave bug you'll go for it.

Well, that's it for this month. As always I will be glad to answer questions concerning this and other related topics (please send an SASE). I have also set up an Internet connection for questions, notes and updates in general. My Internet address for questions and news is: clhough@aol.com. Until next month, 73 Chuck WB6IGP.

Photo A. *Ed Munn W6OJY operates an early WBFM full-duplex transceiver used to win the first ARRL 10GHZ contest. The San Diego Microwave Group helps keep us at the cutting edge of this kind of technology.*

Number 66 on your Feedback card

Radio Fun

Communications Simplified, Part 4

by Peter A. Stark K2OAW
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Having looked at the types of signals we may want to communicate, let's next look at some methods for sending them through wires and fiberoptic cables. Some of the methods we will describe depend on ideas and concepts which we will not cover until later; hence this discussion will be fairly low-level. We will fill in some more detail later, as we learn more about the theory.

Wire communications

When you use a wire connection to send a signal from one place to another, you generally need a minimum of two wires to do it. That's because the wire will need to carry some current (even though that current may be tiny), and you need a complete circuit for the current to flow. So is it possible to communicate with just one wire? The answer is yes...sort of. Let me give you a rather interesting example.

When I was in college, I lived in a dormitory where many of us enjoyed listening to music. But this was in the days before compact discs and tapes could give us an hour or more of non-stop music, and many of us were too lazy to get up every 15 or 20 minutes to change the record. So some enterprising student came up with a scheme for wiring up the dorm so that anyone playing a record could feed that music to anyone else in the dorm who would like to listen to it. We had a 12-wire cable strung around the dorm which carried 12 channels of audio (this was before the days of stereo.) Whenever you wanted to listen to music, you'd first look at the 12 wires to see if someone was playing something you liked; only if you couldn't find something interesting would you need to play your own record; if there was an unused wire at that time, you would send your music into it for others to enjoy as well. In a sense, this was a great cooperative effort at community "broadcasting." (It was also fun to have 20 students all place their speakers in the window at midnight, and all play the same bugle call record at maximum volume at the same time. But that's another story.)

Fig. 1 shows how the system was wired. Each of us in the entire dorm would ground our hi-fi system to the radiator in our room. In addition to feeding the speaker, the output of the sender's hi-fi amp (which came from an output transformer) would also go through a 1/8-ampere fuse to one of the 12 wires in the cable; the purpose of the fuse was to protect the amplifier and speaker in case someone accidentally connected the wire to a power line. Anyone wanting to listen to that channel would then connect an AUX input on his system to that wire through a 100k-ohm resistor, which was also there for protection.

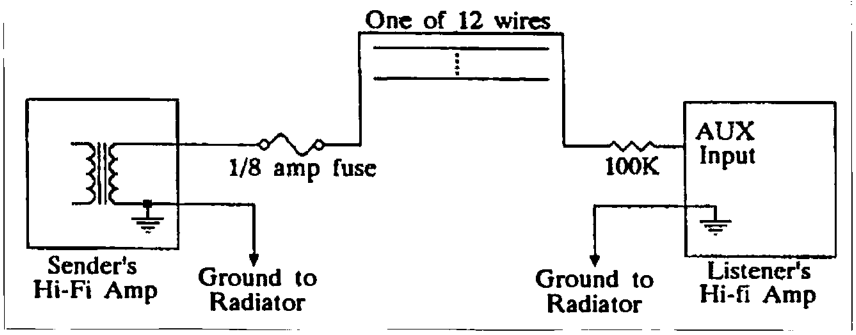

Fig. 1. College dorm music wiring system.

The system worked very well. Some of us connected to the cable with clip-leads, others of us had elaborate switching systems so we could scan or feed the wires just by flipping a switch. But let's look at the system more closely.

First, although this system could be advertised as using only one wire to carry the signal, that's not true. There is another connection that is not so obvious—the ground connection through the radiator pipes. We really had a two-wire system, with the water pipes being one of the two wires. Although we had six buildings tied into the cable, they were all close to each other and all shared the same heating system, so their radiators were all connected together somewhere.

Had the buildings been farther apart, the system might not have worked as well. Although all the radiator and water pipes were eventually grounded (by being connected to some intake pipe buried underground), the earth is not a perfect conductor. (Incidentally, don't count on plumbing being grounded these days—there are enough PVC and other plastic pipes being used that there may not be a connection to ground.) Moreover, there are often other currents flowing in the earth (due to defects or improper power wiring, etc.) which would have caused the grounds in different buildings to be at slightly different voltages. These voltages would have been added to the audio signal, and most likely would have caused hum.

Then too, the 12-wire cable was hundreds of feet long, and snaked on ledges

around the building, through hallways and ceilings, and through basement tunnels. Any time you have such a long wire hanging anywhere, it acts as an antenna and picks up all sorts of signals. Why was this not a problem?

The answer lay in the way each sender's amplifier was connected to the wire. Note that the audio did not come from a preamplifier output or tape output jack—it came straight from the speaker output. An audio amplifier's speaker output has a very low resistance—typically about 1 ohm—and is designed to drive a low-impedance speaker. If the wire picks up noise or hum, the amplifier is strong enough to overcome that and force the line voltage to be whatever the amp wants, not what the noise or hum source wants. In a sense, the sender's amplifier acted as a short on the line, forcing the line to its own voltage and preventing anyone else from affecting it. (For the purists among our readers, the fuse added some extra resistance, but not enough to affect the operation.)

Because of the low-resistance character of the output and wire, it was possible for many students to connect their 100k-ohm resistors to the line at the same time without loading down the line and causing the voltage to drop. As someone connected to the line or disconnected from it, none of us would hear any clicks or volume changes. This kind of a connection, where a high-resistance load is connected to a low-resistance line without any interference is called *bridging*.

Had the output come from a preamp or tape output jack or other "line-level" source, the line would have picked up so much noise and hum that it would have been impossible to use it without some changes.

Shielded wire

One way to prevent an audio signal from picking up interference and hum is to shield it. For example, all the audio cable commonly used between phonographs, tape recorders, and other home hi-fi components (except speakers) is normally shielded wire, such as shown in Fig. 2.

The shield serves three purposes: it prevents outside interference from getting to the inner wire (which carries the actual signal), it prevents the signal from leaking out and affecting other nearby circuits, and it also serves as the second or ground wire, needed to complete the circuit so current can flow.

Shielded wire is used for many purposes, from carrying audio signals to carrying radio frequency (RF) or microwave signals; in the latter case, it is often called *coax* or *coaxial cable*, rather than shielded wire, but the principle is the same. Fig. 3 shows several popular connectors for audio (the RCA phono plug and the phone jack) and for radio-frequency signals (the PL-255 RF connector and the BNC connector).

When properly used, shielded or coax wire does have the advantage of not picking up or releasing stray signals. But it has some disadvantages as well, one of them being that it loses some of the signal it carries. For example, it quite often happens that the signal coming out of such a cable is only half as strong as what went in (or even weaker.) In RF applications, much of this loss is caused by the inner insulator; hence many high-quality cables use air (or even an inert gas) as the insulator, with just a thin spiral-wound strip of insulator to separate the shield from the inner conductor.

"The test current just keeps going forever (at almost the speed of light), searching for a resistor that isn't there."

A second problem, especially in audio applications, is that the shield is so close to the center conductor that there is appreciable capacitance between the two. This tends to short out higher frequencies, so that the cable does not carry high-frequency signals as well as it does low-frequency ones. This reduction of treble response means that this kind of cable is seldom used in lengths over several hundred feet.

A third problem exists in long-distance audio circuits due to the presence of the grounded shield. Audio equipment often has three-wire AC plugs, which ground the cabinet of the equipment through the AC power system. When two pieces of equipment are located some distance apart, these grounds are not directly connected together, and so the cabinets of these two devices may be at a slightly different voltage. When a shielded wire is run between the two, the shield is a second connection between the two cabinets; because of the slight voltage differences, a small 60-Hz AC current flows through the shield and causes a voltage drop. Even though this voltage drop may be just a tiny fraction of a volt, this may not be much smaller than the audio voltage in the cable. This voltage along the shield is then added to the audio signal in the cable, and appears as a hum signal.

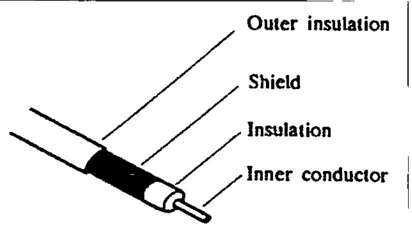

Fig. 2. Construction of a shielded wire.

This isn't much of a problem in a home hi-fi installation, since most home hi-fi components are close together and usually plugged into the same outlet. But it is a major problem in recording and broadcast studios, where signals may have to travel from room to room, or even from one side of town to the other.

Balanced line

Recording and broadcast studios solve many of their wire problems by using *balanced* line, which may be shielded as well, but where shielding is often not even needed.

Fig. 4 shows how a balanced line was used before the days of modern solid-state equipment. With vacuum tubes, the connections to and from balanced lines were usually done with transformers. A center-tapped output transformer would feed the line, and another center-tapped transformer would take the signal from the line. Neither of the two wires in the line was grounded; instead, the ground was connected to the center taps of the two transformers.

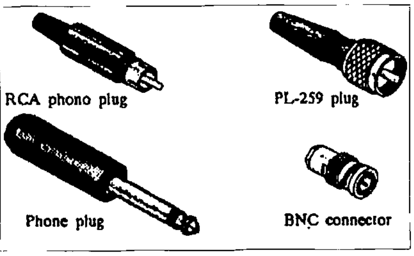

Fig. 3. Several connectors for shielded wire.

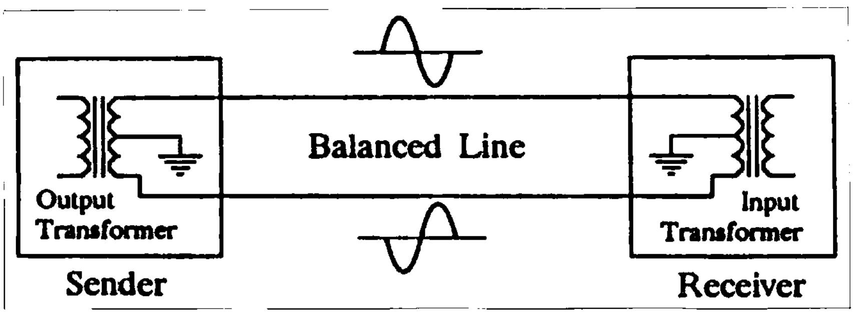

Fig. 4. A balanced audio line.

As Fig. 4 shows, the signals on the two wires are exact opposites of each other—whenever one wire goes plus, the other goes minus by the exact same amount. You can think of this as a seesaw—whenever one end of the seesaw goes up, the other end goes down by the same amount, and the center (where the hinge is—physicists would call it the fulcrum) never moves up or down. We call this type of line a balanced line because the voltages on the two wires are exactly equal (but opposite), so they cancel each other out. (The shielded or coax line, on the other hand, has the signal on the inside lead only, and is therefore called *unbalanced*.)

The input transformer on the right looks only at the difference voltage between the two wires.

Now suppose that there is some external source of electrical noise, which is picked up by the two wires. If the two wires are close enough to each other, they will pick up the same amount of noise. But if both wires pick up the same noise, this doesn't change the voltage difference between them, which means that the input transformer in the receiver doesn't see that noise at all. Shielding is therefore not always needed to keep noise and interference out of a balanced line.

The trick, of course, is to make sure that both wires pick up the noise or interference in exactly the same way. To make sure that this happens, the two wires are usually twisted together, which gives this sort of line the name *twisted pair*. (In fact, one of the favorite buzzwords in modern local area networks is UTP, which simply means unshielded twisted pair.) Sometimes it's interesting to look at some old telephone poles out in the country (or along an old railroad track) and see how they arranged the twisted pair in the old days—see Fig. 5.

There are, of course, some cases where shielding is used in addition to the balanced line. Although the use of a two-wire balanced system cancels out noise and hum, it is not perfect. If the signal is small enough, the noise and hum might still be significant. Thus the microphone cables in recording and broadcast studios are always both shielded and balanced. (Microphone cables in home-type equipment are generally shielded but unbalanced. That's because home-type microphones generally have short cables, whereas professional mikes might be used with very long cables.)

Characteristic impedance

We will look at characteristic impedance in greater detail later, so we will just do it "once over lightly" right now. Think for a moment about how an ohmmeter works. Inside every ohmmeter is a small battery. When you connect the ohmmeter across a resistor, the meter connects that battery across the resistor. Current starts to flow through the resistor, the meter measures how much current there is, and computes the resistance from Ohm's Law:

$$\text{resistance} = \frac{\text{voltage across resistor}}{\text{current through it}}$$

A digital meter computes the resistance in some integrated circuits; an analog meter does it by properly calibrating the meter scale.

Now, imagine (you need a big imagination for this!) that you have an infinitely long length of some cable, such as the flat twin-lead cable used for TV antennas, and you connect the ohmmeter between the two wires at your end. What will you measure?

When you first think about this, you may think that you will measure an infinite resistance—an open circuit. After all, the two wires never touch, so there is no connection between them and therefore no current can flow, right?

Wrong. Connecting the ohmmeter to the end of your cable connects its battery across the two wires. The ohmmeter of course doesn't know whether there is an inch, a foot, or a mile of wire there, so it sends some current out its test leads, hoping eventually to reach a resistor at the end. Normally, the current would reach a resistor after going through just a few feet of wire, and settle down to whatever current Ohm's Law wants. In this case, however, that test current just keeps going forever (at almost the speed of light), searching for a resistor that isn't there. The ohmmeter, however, doesn't know that this test current never reached a resistor; it happily measures the current and voltage, and displays a value of resistance anyway.

The amount of current that flows depends on the kind of cable. Actually, its resistance has fairly little to do with it; it's the capacitance between the two wires, and the inductance of the wires, that mainly determine how much current flows down the cable. The resistance the meter measures therefore depends on the type of cable; we call it Z_0, or the characteristic impedance of the cable.

Different cables have different characteristic impedances—the TV twin-lead is 300 ohms, the coaxial cable used for TV antennas is 75 ohms, while the coax generally used for transmitting antennas is 50 ohms. And the twisted-pair cable generally used for audio and telephone circuits would measure 600 ohms.

Since actually measuring the Z_0 with an ohmmeter requires an infinitely long length of cable, it's not a very practical procedure. But even in shorter lengths, knowing the Z_0 is important because it affects what happens when the cable is connected to a load.

As mentioned above, when we connect an ohmmeter to the end of a cable, the meter sends a test voltage and current down the cable. If the cable were really infinitely long, that current would continue forever. But suppose you cut the cable after some distance, and connect some resistor across the cut end—what happens to that test current when it gets to the resistor?

If the resistor just happens to equal the Z_0 of the cable, then the test voltage and current just flow through the resistor,

and that's the end of the story. The ohmmeter continues indicating the value of Z_0, which is what you'd expect, and that's it.

But suppose the resistor is not equal to Z_0—it is either larger or smaller. Then the test current and voltage eventually hit the resistor, but their values are wrong. From Ohm's Law, the current and voltage would be perfect for a value of Z_0, but the resistance is different and so something has to change. A strange thing now happens—some of the voltage and current bounce off the resistor and start to travel backward on the cable. The resistor is reflecting the voltage and current, and telling the ohmmeter, "Hey, you sent me the wrong values of current and voltage—try again!"

This sort of reflection will always happen if the load at the end of the cable is different from the Z_0 of the cable. This is why engineers often say, "Make sure to terminate (end) the cable in its characteristic impedance." This is the only way to avoid reflections.

DETOUR

Another way to state this is "If the line is more than about 1/100 wavelength long, it should be terminated if you don't want reflections."

The distance a signal travels in the time for one cycle is called a wavelength, and is equal to

$$\text{wavelength} = \frac{\text{speed of the signal}}{\text{frequency of the signal}}$$

The symbol for wavelength is the Greek letter λ. So lines longer than about 1/100 λ can cause problems.

Electric signals in cables travel at somewhere between 65% and 95% of the speed of light, depending on the cable, so about 150,000 miles per second makes a good approximation. If you consider a telephone line carrying audio up to about 3500 Hz, the wavelength is

$$\lambda = \frac{150{,}000 \text{ miles per second}}{3500 \text{ Hz}}$$

which is about 42 miles. So a line longer than about 42/100 miles, or about 0.4 miles, should be terminated. If, on the other hand, the frequency was 100 MHz, then anything longer than a few inches should be terminated.

END OF DETOUR

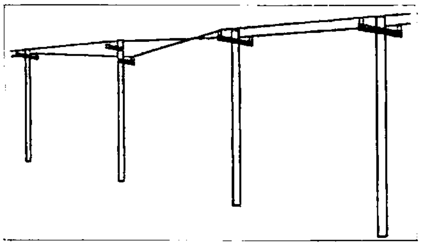

Fig. 5. An old twisted-pair telephone line.

But note that if the cable is short, the reflection may occur so soon that it does not interfere with the original signal. What do we mean by "short"? That depends on the frequencies that are used.

For instance, suppose the signal being carried is a simple 1-volt peak, 1-Hz sine wave signal; that is, a signal which starts at 0 volts, takes 1/4 second to get to its peak of +1 volt, another 1/4 second to get back to 0 volts, another 1/4 second to go to -1 volt, and then 1/4 second to return back to 0 volts. And suppose it takes 1/2 second for the signal to go to the end and the reflection to return to the beginning. Then, just as the +1-volt peak comes reflected back, the input is at -1 volt. The +1-volt reflection and the -1-volt outgoing signal will then fight each other, and this will cause a problem. On the other hand, if the reflection took only 1/1000 second to return, then the outgoing signal would still be pretty much the same, and the reflected signal would not interfere as much. But if the signal was at 500 Hz, then the 1/1000 second delay for the reflection would come at just the wrong time, and there would again be a problem.

The basic rule of thumb is that, if the round-trip time for the signal to get to the end and come back as a reflection is more than a small fraction—1/50 or so would be a rough approximation—of the time for one cycle, reflections can be a problem, and then the line must be properly terminated to stop the reflections. This means that if the one-way time for a signal to get from one end to the other is more than about 1/100 of the time for one cycle, reflections can be a problem, and then the line should be terminated with a resistance equal to its characteristic impedance Z_0.

So let us next discuss the types of cables normally used in communications.

Audio Equipment

Home audio equipment uses plain shielded wire, except to connect the speaker, where the signal is so big that noise pickup is not a problem. Likewise, most cables are short enough that terminating the cables is not important.

Years ago, professional recording and broadcast studio equipment used 600-ohm balanced cables almost exclusively (except for 50-ohm cables for microphones, and unshielded wires for speaker connections.) Broadcast stations still tend to stick with 600-ohm balanced cables, partially because they still use old equipment, but also because they need the benefits of balanced cables. Not only do they tend to send signals longer distances, but many stations also place their studios close to their transmitters, and have the additional problem of having to keep the high-power transmitted signals out of their audio circuits.

But recording studios have gotten somewhat lax about it. There are two reasons for this. One is that the best way to get a balanced line is with a transformer; but recording studios try to stay away from transformers because they degrade the audio quality slightly. The second reason is that there are many small-time studios which operate on a budget; unbalanced equipment and connections are cheaper, especially since home equipment has gotten so good that many studios use a mixture of professional and home equipment. 73

Number 70 on your Feedback card

The Tech Side: More Adapters

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Last time, in *Radio Fun*, we were exploring the subject of AC adapters, and looking at how you mate an adapter to an unrelated gadget. Let's continue:

Voltage and current

You've ascertained the proper polarity, and now it's time to deal with the voltage issue. Can't you just match the voltage stated on the adapter to the device's required voltage and be done with it? Sometimes that works fine. Other times, though, you can wind up with problems.

Let's say you have a 6 volt device. How can you be sure it takes 6 volts? Usually, the required voltage will be stated on the case, next to the DC input jack, or it may be on the back, somewhere near the battery door. If there is no marking, count the number of batteries and multiply by each battery's voltage. So, if the device takes four AA cells, you know that's 6 volts because 4 times 1.5 (an AA cell's voltage) equals 6.

Occasionally, you may run into something that requires a higher voltage at the DC input jack than would be given by the number of batteries the gadget uses. I've seen some products that operate from 6 volts' worth of batteries but take 9 volts at the input jack. (Although I've never seen it the other way around, I suppose it is possible.) In most cases, such a device will still work on the lower voltage, but not always. Knowing this, however, is *not* a license to try higher voltages if your hookup refuses to work. Excess voltage can quickly ruin your device! Usually, failure is due to other problems, anyway. But, if you can't get the AC adapter to work, and you've tried all the techniques I'll be describing here, then try and get some service data on the equipment from the manufacturer or others who own the same product, to be sure of the input requirements. Don't just crank up the voltage and keep trying, or you may very well be sorry. There's nothing like that sinking feeling when the unit's lights go out and the first wisp of smoke appears. Remember, electronic circuits operate on smoke: once you let it out, they don't work anymore!

Assuming that you *do* know the correct voltage, here's where the fun begins. Logic would suggest that you could simply match the voltage with the one printed on the adapter, verify the polarity and plug it in. Logic would be wrong. The problem with this scenario is that the printed voltage on the adapter isn't a constant. Almost all AC wall cubes are unregulated. That is, they don't really produce their stated voltage except when at their rated current load. So, if your adapter is rated to deliver 6 volts at 700 mA (milliamps), it may deliver 8 or even 10 volts at significantly lesser load. While you don't need to get the input voltage exactly right, being 50 percent too high is asking for trouble! And, being too low by such a significant amount will probably cause the unit to malfunction, if it'll work at all. In order to get it all working right, you need to know the approximate current demand of your device. Chances are, that value will *not* be printed on the case!

Test it

There are various ways around that problem. If you have a current scale on your VOM (volt-ohm-milliammeter) and a variable power supply, you can simply feed the gadget the correct voltage and measure its current draw. Remember, the meter's leads go in series with the power supply, not in parallel across it. Although it usually won't matter which lead you choose to interrupt for your current measurement, use the ungrounded one, usually the positive, to be sure you don't cause a ground loop (an unwanted flow through an alternate path), which could confuse your reading and, in rare circumstances, even cause damage to your device.

If your shop is not so blessed with gear, there are some other things you can try. Take an adapter rated for the required voltage, with the smallest current capability you can find. Hook it up and try it, remembering to observe the polarity. Most likely, it won't put out too much voltage; it'll probably be too low. If the device works fine, you're home free, as long as the adapter doesn't seem to be heating up a great deal. If, though, it exhibits AC hum or seems weak in some way, it has given you a valuable piece of information: Your device requires more current than this adapter can deliver! Make a note of the adapter's current rating and try another one, this time with a higher current capacity.

Eventually, you'll get to one that works. Or, if you don't have any others, you can use your measurements to deduce how to use what you have. If, for instance, you need 9 volts but have only 7.5 volt adapters, try using one with a fairly high current rating. That way, it may put out something around the 9 volts you need, because it can supply more current than is required, raising its voltage above the rating.

Going the other way, though, is asking for trouble. *Don't* use a 9 volt adapter with a small current rating to power a 6 volt device, with the idea that the excess current demand will lower the adapter's voltage. It will, but it'll also cause AC hum and, more seriously, heat up the

Continued on page 75

Welcome Newcomers!

Wayne Green W2NSD/1

With the facts of life telling me that around 95% of ham newcomers these days are dead-ending on 2m, maybe you can give me an idea of how to get them excited enough to upgrade and join us old timers down on the DC bands. I've tried pointing to the adventures that hamming has provided for me. "Oh, there goes old Wayne blowing his horn again."

On the other hand, if the spirit of adventure has either been blown out, or has never been kindled in their minds, I'm wasting both my time and theirs. Almost anyone can learn the stupid code and get the Advanced Class ticket and enjoy everything hamming has to offer.

Yes, of course it takes money to go on DXpeditions, but if you have a spirit of adventure and the ability to work for a goal, making money is a snap. It's this spirit that gets a treasured few hams to be active on our satellites, helping packet grow and speed up, winning contests, and so on. It's the spirit that gets people to read and learn. It's this spirit, according to Ray Kroc, the chap who gave us McDonald's, that determines winners and losers in life.

I've spent a lot of time up here on my soapbox, waving my arms and trying to get hams to take advantage of the world of adventure hamming provides. Eyes glaze over. Yawns. I want to get as many people to share the excitement and adventures I've experienced, so I talk at conventions and write about the things that have helped make my life so interesting. The fun of hearing your voice come back from a ham satellite, delayed a little by the distance. The thrill of downhill skiing when you're good at it. The indescribable feeling of scuba diving on a coral reef. The exhilaration of beating down a pileup from some weird country. The feeling of making a 10 GHz contact in another state while freezing your fingers on top of a mountain. The joy of hearing ragtime piano played by an expert. The rapture of reading a book and learning something new.

These are feelings that movies and TV can't evoke. Oh, there have been a few darned good movies, but even the best don't compare with the feeling you get from working country number 330 or making that slow scan contact with the Canary Islands. Or an aurora contact on 2m a thousand miles away. Or a moonbounce contact with VK3ATN or HB9RF.

The code? Sure, let's keep plugging at getting rid of that obstacle, but in the meanwhile stop using it as an excuse. Yes, I know, you have dyslexia or some other stupid excuse. Just shut up and use my method to learn the code. If you're too cheap to buy my code tapes, then get a program for your computer that will send the code at 13 or 20 per and save the $7.

No, I'm not at all in favor of lowering the standards, just in getting rid of an artificial barrier which these days has nothing to do with technology. This is a high-tech hobby. We should be using it as a gateway for kids to get started learning the fundamentals of electronics and communications. The 21st century is going to be unforgiving of people who are not high-tech literate. And what more fun way to learn than by amateur radio?

In the past all of the major discoveries and pioneering in radio communications was done by amateurs. We pretty much stopped doing that 30 years ago, thereby abrogating the lease requirements for our ham frequencies. Fortunately our landlord hasn't noticed that we've stopped paying the rent. But the increased pressure from commercial interests who want our bands may eventually get through. Money talks, and we're beggars, living on past glories.

1200 baud packet? Give me a break! 28,800 baud is getting to be the standard on the Internet and 56k is coming along fast. So what have you done to help get us up to speed? Yes, I know, you have an HT on your belt. Well, I did that back in 1969. Heck, I had my own repeater on Pack Monadnock Mountain in 1969, providing contacts over almost all of New England. And that's almost 30 years ago. More than a generation.

If you put your mind to it you could be an expert on packet in a few days. Weeks, at the worst. If they can cram 56k baud over a crummy phone line, you should be able to zip it over the air without dropping a baud, and never mind tropospheric multi-path distortion.

Quiz: how many words per minute are 56k bauds? Now where's my trusty old hand key? With some decent baudy work a DXpedition could flatten a pileup in seconds.

I've done some research that you haven't bothered to yet, so I know how to cure almost every human illness and to live to 120 or so in good health, so if by some magic we manage to hold on to some ham bands, I expect to be one of the pioneers who helps us develop a system where we'll be able to work every licensed ham in the Callbook in one day. And they'll all be reachable, too. Or at least their stations will be.

I've been writing about health in my editorials. How about an antibiotic which microbes can't mutate to avoid? One that you can make at home for fractions of a cent? The medical industry is going to go bananas if word of this gets out.

How about a cure for any blood-carried illness that costs pennies to use? One that'll wipe out any virus, bacteria, fungus, or parasite in the blood? I'll be writing more about all that. You'll still be able to fall off your tower or get across the final plate voltage and expire, but it won't be the slow, lingering death most people are suffering.

Well, that's just one of my recent interests. I'll tell you more about all that on 20m, or if I get invited (all expenses paid) to talk at a hamfest near you. Yes, of course I'll talk about amateur radio too.

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Radio Magic

by Michael Bryce WB8VGE

Troubleshooting Your New Kit

What do you do when the darned thing doesn't work?

Still can't find out what is wrong with your new kit? Often another person can spot something you have been passing over. However, if even that doesn't work, then let's dig out the test gear and see what we can find. Here's the drill. Say the project is not entirely dead, but just not working like it should be. Really "dead" kits are usually easy to fix.

The first place to check is the power source. It may be as simple as a 9 volt battery, or as complex as a switching-regulator supply. Let's check to see if there is voltage coming out of the source and if that voltage is enough to operate the unit. A digital VOM comes in real handy here. If you don't have one in your tool box, it's time you did.

Attach the black lead of your VOM to the ground side of your unit with a clip lead. Radio Shack™ carries a nice selection of clip leads, so pick up a bag or two. The ground is normally the negative side of the battery/power supply or the common ground bus around the PC board.

Now, with your VOM's positive probe, touch the positive side of the battery or power source. Let's use our example of a 9 volt battery. Your VOM should read at least 8 volts or higher with a fresh battery. Now, turn your kit on. Did the battery voltage drop way down to, say, 5 or 7 volts? It did? Well then, either you need a fresher battery, or you need to take a closer look at the current flowing to the unit. To do this we need to switch our VOM to display current and insert the VOM in *series* between the battery and our kit. This is simple to do when you're using clip leads. As our project is running from a 9 volt battery, it's easy to snap off one battery clip and give it a slight turn to expose the now bare battery terminal. It makes no difference which battery terminal we use—the digital VOM will read the current either way. If we connect the VOM up backwards it will display a "-" to the left of the display. This of course only works with a digital VOM and not the older analog types.

Attach one clip to the bare battery terminal and another to the battery clip. Select current with the VOM switch and then select the proper current range. Since this device is running from a 9 volt battery, select one of the lower current ranges. It is good practice to select the highest current range and then reduce the setting until a valid reading is obtained. A 500 to 200 mA range is a good start. It's only a 9 volt battery, so your unit shouldn't draw a lot of current.

Turn on the power switch and note the current being drawn on the VOM's display. Hmm, the meter reads 80 mA, so now we can see why the voltage dropped. That's a lot of juice for a single 9 volt battery. They are designed for loads of just a few mAs to maybe 20 mA on the high end. But 80 mA? Nah, that's way too much current. And that means you have something drawing all this current. All you have to do is find what's doing it. You've got about a 112 ohm resistance from B+ to ground in there somewhere instead of 450 ohms or more.

Some possible causes are a shorted output device, audio amp, or RF amplifier; electrolytic capacitor(s) installed backwards; leaky electrolytic capacitor(s); IC chip(s) installed backwards or in the wrong location; the voltage regulator installed backwards or in wrong location; a solder bridge between two or more PC traces; or even the battery installed backwards.

"Even with the simplest test gear, we have been able to determine several causes and their fixes."

Or let's say we measured the battery voltage and it did not change when we turned on the unit. We connected our VOM to read current and the current displayed was zero. So what's wrong? There must be a break in *series* with the supply. Let's look for some possible causes such as a broken battery connector, a reverse-polarity protection diode installed backwards, a bad battery wire solder junction to the PC board, a solder flux insulator around the plus supply wire on PC board, a defective crimp on connector, or the battery connected backwards.

Of course, in both cases, it is possible to have another problem causing either excessive current or no current. But check out these quick fixes first.

When there's excessive current flowing, there is a good chance you can feel for the defective part. Even at only 60 mA, something is going to get warm. So, with your fingertip, carefully touch each part to see if it is running warm or even hot. *Don't do this test with any piece of gear running from a 110 volt supply or one with high-voltage circuits inside.*

If you come by a component that is hot to the touch, then turn off the project and take a closer look at that section. Remember, the hot part may not be the fault. It may be running hot because of something else down the road.

It's very easy to swap a small three-terminal voltage regulator with a transistor. They look the same, but are hardly interchangeable! If this fate befalls you, then you can bet the farm that the regulator is cooked. Luckily, they're not very expensive. You have to remove the one already installed backwards, so you may as well replace it with a brand-new device. The lesson here is: If you hook up a solid state device backwards or install it incorrectly, it's more than likely bad. Just replace it and put the whole mess down to experience!

The above examples point to two fundamental facts about current and voltage. Even with the simplest test gear, we have been able to determine several causes and their fixes. 73

HAMSATS

Number 74 on your Feedback card

Amateur Radio Via Satellites

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When OSCAR-1 was launched nearly 35 years ago, amateur radio operators didn't have computers for orbit predictions. The chore was attacked with slide rules and pencils. With a few pieces of information, it was possible to predict when the satellite would be within range, but the process was tedious.

During the next decade special maps and clear overlays were used to predict satellite positions. Using an OSCAR-LOCATOR kit and a few simple pieces of data (equator crossing time and longitude of crossing), tracking was relatively easy and inexpensive.

The late 1970s and early 1980s marked the arrival of the home computer for satellite pursuits. While many new owners of Radio Shack TRS-80s and early Apple computers were wondering what to do with their new and expensive toys, hams were tracking satellites with ease and incredible accuracy. Even Sinclair ZX-81 fans could plot the paths of complex orbits.

Today's PCs make satellite tracking a simple task. Many software packages exist that not only predict access times, but provide real-time simultaneous tracking of many satellites with graphical earth views and automatic antenna pointing. Most ham radio BBSs and ham-oriented Internet sites (try ftp.amsat.org or http://www.amsat.org) have some shareware and freeware programs that will do the job.

The numbers

One thing that all satellite tracking methods have in common is the need for orbital data to characterize a particular satellite's position in space at a given time. This data is commonly referred to as "Keplerian elements" or just "element sets."

Due to atmospheric drag and other effects and inaccuracies that accumulate with time, new element sets are needed to maintain the prediction accuracy of the software. Some satellites with high, stable orbits may only need new data once a year, while other low orbit objects with changing orbits, like the MIR space station, could use a new set every week.

Table 1 shows an element set for AMSAT-OSCAR-13 presented in standard "AMSAT" format. Many satellite enthusiasts get element sets for all the satellites they wish to track from packet radio, BBSs or the Internet, usually the same sites where tracking software is found. The element sets are in a standard text file that can be placed in the same directory as the tracking program. The program typically has a menu choice allowing automatic updating of its satellite database from the element-set file.

With such an effortless process to get new data running, it's understandable that many users are not aware of the meaning of the numbers. It's not necessary to have a degree in mathematics to work with element sets, but some knowledge of their significance is useful. Sometimes blatantly bad element sets are released, or satellites are given the wrong identifier shortly after launch. A quick look at the element set may reveal a ridiculous Decay rate or impossible Mean motion.

The set in Table 1 describes an orbit that is elliptical with a high apogee occurring over the northern hemisphere. There is very little atmospheric drag and the time to make one orbit is just under 12 hours. A description of the individual elements can explain these quick observations and more.

Catalog number	1	9	2	1	6										
Epoch time		9	6	0	1	1	.	3	8	4	7	5	8	4	0
Element set		1	3	4											
Inclination				5	7	.	4	0	2	9	d	e	g		
RA of node			1	4	1	.	8	2	2	7	d	e	g		
Eccentricity		0	.	7	3	6	6	0	4	3					
Arg of perigee				2	8	.	7	6	0	7	d	e	g		
Mean anomaly			3	5	6	.	7	5	8	7	d	e	g		
Mean motion	2	.	0	9	7	3	1	2	5	1	/	d	a	y	
Decay rate		-	4	.	4	4	e	-	0	6	/	d	a	y	2
Epoch rev							5	8	0	1					
Checksum								3	0	6					

Table 1. AMSAT-format Satellite AO-13 element set.

Satellite:

The first entry is an informal name that is distinct to this satellite. AO-13 is also known as A-O-13 or AMSAT-OSCAR 13. The "OSCAR" part of the name dates back to the first ham radio satellite, OSCAR-1, and stands for Orbiting Satellite Carrying Amateur Radio.

Catalog number:

NASA assigns formal identification numbers to all man-made orbiting objects. Vanguard 1, launched on March 17, 1958, is still in orbit and has Catalog number 5. AO-13 was launched on June 15, 1988 and is listed as Catalog number 19216. The Catalog number should not be confused with the International Designation number which specifies year of launch, launch number since the beginning of the year and object letter identifier. AO-13's "ID" is 1988-051B.

Epoch time:

Note the example in Table 1. The Epoch time is 96011.38475840, defining the moment when all of the numbers in the element set were measured or derived. This corresponds to year 1996, day 11, followed by the "decimal day" of 0.38475840. Using the fact that there are 24 hours in a day, 60 minutes in an hour and 60 seconds in a minute, the "normal" time format can be found as 9 hours, 14 minutes and 3.126 seconds. Thus 96011.38475840 is the same as January 14, 1996, at 9:14:03 UTC. UTC stands for Universal Coordinated Time. If you are not already logging your ham activities in UTC (same as GMT), working with satellites will provide the needed boost. All satellite predictions use UTC. Conversion to local time zones is a feature incorporated in most software.

Element set:

This entry identifies the element set. Set number 134 is obviously more recent than set

130. Sometimes the set number may include other clues as to its origin. James Miller G3RUH has been releasing "smoothed" element sets for AO-13 and AO-10 that represent averages of several NORAD/NASA sets. The G3RUH sets' accuracy over time is better than the NORAD/NASA sets' and have names like RUH8-95, for a G3RUH set done in August 1995. Space Shuttle sets may also have letters in with the numbers, depending on their origin.

Inclination:

The inclination of a satellite's orbit is the angle of the path of the orbit as it crosses the equator of the earth while moving south to north. A polar orbit that travels from pole to pole will have an inclination near 90°, while a satellite that follows the equator will have an inclination near zero.

RA of node:

The RA of node or RAAN is the Right Ascension of Ascending Node. This element is one of the most difficult to understand. A simple definition describes RAAN as an angle that specifies the orientation of a satellite's orbital plane with respect to the fixed stars. The satellite's orbital plane is relatively easy to visualize. The difficult part is to envision the creation of an angle between this orbital plane and the "fixed stars." In the case of the NASA element sets, the line to the "stars" is drawn from the center of the earth to a star in the constellation Aries. The angle defined by the intersection of this line and the satellite's orbital plane at the time of the Epoch is the RA of node.

Eccentricity:

The Eccentricity term refers to the shape of the orbit. No orbit is exactly circular. If it were, this element would have a value of zero. The Eccentricity of AO-13 for the element set in Table 1 is 0.7366043. This shows that the orbit is highly elliptical. Due to the influence of the moon, AO-13's orbit is becoming more elliptical every day. Most tracking programs cannot predict this change due to their inability to handle gravitational forces beyond the earth-satellite interaction. For most ham pursuits, this is not a serious problem, except when a satellite crashes to the earth, like AO-13 will, in December of this year. Updating the element sets each month until the end will at least provide accurate tracking predictions for making contacts and enjoying this orbiting resource as long as possible.

Arg of perigee:

The Argument of perigee is another "difficult" element. It describes where the perigee (or low point) of the orbit is located in the satellite's orbital plane. If the perigee occurs when the satellite is crossing the equator on a south-to-north pass, the angle from the equator to the perigee point is obviously zero (they are occurring at the same place), therefore the Argument of perigee would be zero. The apogee, or high point of the orbit, would occur 180° (half an orbit) later, also on the equator.

For the example in Table 1, we have an Argument of perigee of 28.7607°. This means that AO-13's perigee is occurring 28.7607° after crossing the equator while headed north. The apogee is thus occurring below the equator, half an orbit later.

Mean anomaly:

Mean anomaly locates the satellite in its orbital plane at the time of the epoch. All programs use standard astronomical convention for this element. The satellite is at 0° or 360° at perigee and 180° at apogee. In our example the value of 356.7587° is very near perigee for AO-13 at the Epoch time noted.

Mean motion:

This element simply specifies the number of orbits (perigee to perigee) the satellite makes in one solar day (1440 minutes). In the example, AO-13 is making slightly more than two orbits per day, thus each orbit is a little less than 12 hours.

Decay rate:

The Decay rate of a satellite's orbit is also defined as the rate of change of Mean motion, the first derivative of Mean motion, or as the drag factor. It provides a correction to the Mean motion that accumulates with time after the Epoch of the element set. Satellites with high orbits have very little orbital decay, while objects like the Space Shuttle or MIR have significant values associated with this element due to their low orbits and corresponding atmospheric drag. The Decay rate in the example is a very small negative number shown in scientific notation. The -4.44e-06 value can also be written as - 0.00000444 rev/day/day (orbits per day squared). The negative value in this element set for Decay rate is not typical but may be a result of gravity pumping or caused by the method of data collection by NORAD.

Epoch rev:

This is the orbit number. While satellite enthusiasts used to keep close accounting of orbit numbers for QSL cards and logs, this is no longer the case. In many instances, the orbit number shown in the NORAD/NASA element sets will differ from calculated values. Differences occur due to the definition of orbit number 1, or is it orbit number 0? The question of when the orbit increments also comes up. Do we increase the count by one when the satellite passes through perigee or when it crosses the equator on a south-to-north pass?

Checksum:

This is simply a math function to verify the validity of the numbers in the element set. It is the total of all the individual digits in the set. Some programs use the checksum. If the checksum value and the total of the digits match, the element set is assumed to be correct, at least the data is assumed to be the same as when it was first calculated.

The Tech Side: More

Continued from page 70

adapter, possibly to the failure or meltdown point! It's normal for AC wall cubes to get warm with use, but they shouldn't get hot. Lots of heat is a dead giveaway that you're trying to pull too much current from an underrated adapter.

Wrap it up

Once you've matched the current capacity of the adapter to the device you want to power, you should be all set. Connect it up (don't forget that polarity!) and it ought to work fine. While it's running, measure the voltage across the DC plug; it should be within a volt or so of what the product needs. I prefer to err on the low side, because of the lessened chance for harming my gadget, but, as long as you're close, you should be OK. Remember, the original adapter probably wasn't any closer! I've taken measurements on plenty of circuits, and I've seen many original-equipment adapters off by as much as two volts. As far as I'm concerned, though, that's a lot, especially if it's on the high side.

I hope you've enjoyed this look at AC adapters. If you're at all like me, you'll use this information often; I can't count the number of AC adapters I've rigged up. With this in mind, look around at the next hamfest for cheap adapters for your junque box. I always keep a good supply, and I always wind up using them! Until next time, 73 from KB1UM.

NEVER SAY DIE
Continued from page 63

to de-license the reason-challenged hams (oops, I slipped and used the word "challenged." The last time I used the term "reason-challenged" I got angry letters from several crippled hams who went ballistic over my using the term "-challenged" and claiming that, just as they suspected, I was anti-crippled hams) as it is for them to get their license, we might be able to clean up our bands. But when we have hams who cause three years of aggravation, who force the ham clubs to go to court to get a restraining order, and then harass the repeater anyway, and to hell with the court order, it's time to see if we can get the FCC to make it easier to take ham tickets away than to give someone the death penalty.

I suppose you're going to sit and nod. Yep, Wayne's right again. Well, how about sitting down and going to work to get Part 97 changed so we can get rid of the scum, even if they can copy the code real good.

We seem to be able to get enough idiots licensed so that ring-leader jerks are able to recruit others of even lower mentality. We had a whole set of scum busy wasting 14313 for us, doing everything in their power to shorten the life of the hobby for all of us. Well, we deserve every hit we get if we're not smart enough to shut these turkeys down by ourselves, instead of going mewling to the FCC for help, which has more than enough to do without wiping our tushes for us. Hey, shouldn't our national organization be *doing* something for us?

And we seem to be able to endlessly put up with the hot air and self-promotion emanating from Maine all hours of the day and night. Can't we get him to settle for a web page? Somehow I think the pioneering spirit that founded this country got killed by our 60s school system, leaving us with almost no one who will stand up and fight for what's best for us.

I suppose the Viet Nam war did a lot of that too. In WWII we knew what we were fighting for and we all pitched in. As I've mentioned a few times, 80% of the hams joined the military.

Grumble.

Instead of wasting all that time and money with a repeater war, why not shut the darned thing down, take up some other hobby and stop screwing things up for everyone? And that goes for both the bad guys and the righteous. A pox on both your houses.

A Limbaugh limiter

Reader Louis Burkhardt N5LTP, of Los Alamos NM, suggested a product which might sell like burritos. It's something any dyed-in-the-wool ham should be able to put together. It's a radio talk show commercial filter. By the time you sift out the commercials, Rush's three hours will boil down to almost listening length. Ditto Liddy, and anyone else you're addicted to.

The hard way would be to sense the louder voice from commercials, but I suspect if you check the clock you'll find that the commercial and news breaks are fairly consistent day to day. If you time the Limbaugh breaks for one day the pattern will probably hold pretty well for months. That's how the stations carrying his program know when to run their commercials.

There's an outfit making a tape recorder to capture three hours of voice quality on one tape, but the price is high. I think it was around $200, which I'd rather spend on a 30-day pass to fly around the Caribbean. How about a circuit to cut a three hour radio talk show down to 90 minutes so I can set a C-90 cassette going and build a library of Art Bell shows? Or Laura Lee? Or anyone else that's running shows I shouldn't miss, but which you negligently have failed to let me know about.

Once you invent these, I'll bet there'll be a good market for them.

XYL maintenance

Many perfectly nice but näive women marry hams with no idea of what they are getting into. Sure, there are a few hams who can take it or leave the hobby. But many more are far more interested in amateur radio than in their marriages. Or even their families. I remember running a cover cartoon on *CQ* when I was the editor showing a ham sitting in front of many relay racks of equipment while his wife and baby were standing behind him in rags.

Sure, it was funny because it was an exaggeration. But a good part of the humor was the underlying truth of the situation. Hey, guys, try to remember that amateur radio is a hobby. It's for *fun*! You'll have a lot more support for your hobby if it isn't perceived as a competitor for your wife's affections.

Several hams I've known personally were divorced by their wives with ham radio named as the corespondent.

When's the last time you took the XYL out to dinner and a movie? Or, if you're thrifty like me, to a matinee and then dinner? Or maybe read the non-ham parts of my editorial to her? When's the last time you took her dancing? I have a secret I'm going to share with you: wives love romance, not rigs or nifty HTs. And nothing says romance like dancing.

Oh, you've forgotten how to dance? Then get a how-to-dance video, put it on, grab her and you'll soon have a very happy wife, with a sparkle in her eye and the bedroom in mind. The effect has been known to last for days. No fair doing this just before trying to get her to agree that you really should have a new rig. But after you've taken her out to a couple of dances she might bring up the new rig subject on her own.

Where do you get dance videos? I thought you'd never ask! They're one hour lessons and cost $42.95pp from Butterfly Video, Box 184, Antrim NH 03440. Call 800-43 DANCE for a catalog showing the nearly 100 different kinds of dances available. They even have some for kids. They've got 'em for rank beginners right on up to competition dancers. In this way you can romance your wife at home while you're learning, practicing when it's handy for you instead of going out to a class (which usually costs a lot more). And you can brush up when you've forgotten something.

I've several friends whose wives hate hams. None of them ever take their wives out dancing. Bet on it. Our hobby should be seen as that and not as a competitor for your wife's and kids' affections.

I recommend the Butterfly Videos because they're so outstanding, and I've seen 'em all. Kathy Blake is the teacher and she's won all sorts of prizes. But most important, she knows exactly what questions you're going to have and what problems, so she makes it simple and fun to learn.

Okay, now you can go back to your shack and find a pileup to molest.

Like to make some money?

I'm looking for a few go-getters to sell *73* subscriptions at hamfests. There are tons of hamfests, picnics, auctions, flea markets and other ham events where you could set up a table and make a few bucks on a Saturday. You should be able to pick up from $100 to $500 a Saturday. Remember, far too many hams aren't yet subscribing to *73*, and every one of 'em should be...and might, if you get after 'em.

Plus you can sell some of my books too (on commission). My list of "73 books you're crazy if you don't read" is selling like Big Macs. Well, at $3, even if they only buy one of the books I recommend, they'll get their money's worth just finding out about it. Then there's my "Declare War" book, subscriptions to *Cold Fusion*, and the booklet describing how to make a blood purifier which Bob Beck claims will not only completely cure AIDS, but also any blood-borne disease such as herpes, cause your body to get rid of excess weight with no dieting, and even regrow hair for male pattern baldness people.

The midwest territory is taken, but I could use energetic help in the Northwest, Northern and Southern California, the mountain states, the Southwest, the South, the Eastern Seaboard, and the Northeast.

There's quite a lot of interest in a $5 booklet I wrote recently as a result of requests from listeners to Art Bell's (W6OBB) talk radio show. This is "How To Make Money, A Beginner's Guide." Well, once you know the secret you can get out of the rut that 99.99% of the people are in, a rut of thinking that results in your never having very much money. It's a rut that is deeply engraved in our subconscious by our blessed school system and media. The more rich hams we have, the more clout we'll have with the FCC and congress.

I'm looking for hams who will get out there and not miss a hamfest within driving distance. Anyone want to help shake the money tree on Saturdays for me?

Falling behind

I can remember when we hams were in there first with new technologies instead of following far behind commercial developments. We hams invented FM and then NBFM. We invented practical sideband. But now the world is going digital and we're still fighting over CW.

Our telephones are going digital. Our hi-fi went digital over ten years ago. Now broadcast stations are going digital in one country after another. Blaupunkt, Grundig, Philips, Sony, Pioneer and Kenwood all either have receivers on the market or will have soon. No, no American companies.

With digital, each transmitter can broadcast five programs of CD-quality sound, plus data such as a newspaper. The conversion of AM and FM to digital will, I expect, happen faster than anyone imagines, just as we saw the LP become almost extinct overnight when the CD was introduced.

Some digital tests are being conducted in San Francisco, so we'll see how they go. The early tests in England ran circles around both AM and FM broadcasting in quality and coverage, as I reported several years ago.

There must be some readers who are working in this field who can help the rest of us come up to speed. Maybe with ideas on how we hams can start experimenting with digital voice communications. I'd like to see articles submitted for me to publish so we won't keep falling further and further behind the commercial state of the art. After all, it says in the lease for our ham bands that we're supposed to be leading in technology, not kicking and heel-dragging to stay 40 years behind the commercial world.

Meanwhile, people in Britain, Denmark and Sweden are already enjoying digital broadcasting, with France, Hungary, Australia, Netherlands, Canada and Mexico not far behind.

A dying breed?

With under half of our surviving hams (45.5% now) having better than entry level licenses, and with the majority of "hams" having no apparent interest in ever upgrading so they can work the low bands, perhaps you can understand why I've been researching more and more into ways to help us aging survivors add a few more years to our lives. The politically correct, who can go jump in the lake, can call me elitist, for feeling sorry for the 54.5% of our licensees who have isolated themselves into what is increasingly being called an HT-CB band.

Sure 2m and repeaters are fun. But when I started promoting repeaters in 1969 I never thought that this activity would eventually dominate the hobby. My aim was to revive a dying hobby. What I hadn't recognized was that the almost complete elimination of our school radio club infrastructure by the ARRL's 1964 "Incentive Licensing" proposal to the FCC would permanently end our ability to attract youngsters into the hobby in any real numbers.

So, in between hectoring you to get the Techs to come to your club meetings and encourage them to upgrade, and getting on 2m yourself to help inculcate these new arrivals with our ham culture, I've been finding out all I can about how what's left of us can lead longer, healthier, and yes, maybe even happier lives.

As I've researched more and more about health, I've been recommending you read the most important books I've found. The more I've looked into this health thing, the more I'm convinced that if we can change some destructive eating and living habit patterns, we have the potential for living healthily to 120-150 years. But the obstacles are monumental and at times discouraging. Habits run deep. It seems like most people would rather enjoy a Big Mac now and endure years of chronic illnesses than live 75 more healthy years later on. How do you convince a 13-year old that starting a smoking habit now can lead in about 40 or 50 years to a nursing home with an oxygen bottle always at hand. How do you get people to stop drinking fluoridated tap water which may eventually turn them into Alzheimer veggies in nursing homes, not even able to recognize their own children or spouses?

If you read some of the books I'm recommending I think you'll find that every chronic illness can be attributed to either a nutritional deficiency or to our slowly poisoning ourselves one way or another. And with the average age of the General and above class licensees getting up into the 60s, unless I can convince them to break their destructive habits, we're goners. Pity, too, now that the short waves are increasingly being deserted for the microwaves and satellite communications. Pretty soon, what few are left of us will be about the only ones using the 3-30 MHz part of the spectrum. We might eventually get back our 7-8 MHz and 14-15 MHz bands. And then everything else except perhaps the WWV and CHU channels.

Of course, like the 13-year-old smoker, we're ignoring the inevitable loss of our most valuable future bands. Well, that's our legacy to the coming generations, like the national debt and the using up of coal, oil and other natural resources. Who really cares what happens to our 10 and 24 GHz bands? Our vision ends either tomorrow or next week some time, as it does with our health.

When the Bob Beck blood purifier turned out to cause people to lose weight without changing their eating habits, there was a rush to build and use these simple electrical gadgets. The key point was that then an eating habit didn't have to be changed. Yes, I agree, it takes a lot of determination to change habits.

I was a skinny kid until I got vaccinated. Then suddenly I developed a whole range of allergies and got fat. And I stayed fat until I was 50, when I finally decided to break that habit. I cut back to a 1500 calorie a day diet and took off over 85 pounds over nine months. 23 years later it's still off. I broke that damned habit. My approach was much like that used by Alcoholics Anonymous. Don't break your determination for anything. Not once. None of that "I'll eat that chocolate sundae today and diet tomorrow" crap.

Once you have discovered that under all that moss back there is a backbone, you can exercise it more. Use it to get you out every day for a couple miles of brisk walking. Use it to break away from the deadly pattern of always working for someone else. It takes real guts to break away from the protection of a weekly paycheck. Until the company downsizes and you're suddenly on your own. Then you blame everyone but yourself for the fix you're in.

Big companies downsize to get rid of older employees, replacing them with much less expensive and more flexible younger people. Or computers. Smaller companies go out of business. The steady lowering of communications and shipping costs puts you in more and more direct competition with a worker in Taiwan or Pakistan. And these competitors for your job work cheaper, and are better educated than you, since you've allowed your school system to sink to the worst in the developed world. You're unlikely to have either security or make much money working for others. But it's a powerful habit to break. I've been there, done that, so I know how it feels.

Even if you can't wean yourself from the comfort of a company paycheck, you can at least start breaking some eating habits and have a better shot at living in poverty on Social Security.

To the moon, Alice!

The hot fusion scientist welfare crowd is almost getting panicky over their lack of progress. They've wasted billions on fruitless attempts to fuse lighter weight atoms, thus generating energy. Indeed, I've published some papers in *Cold Fusion* showing that not only has there been almost no hot fusion progress, but that the future seems just as grim.

But now these poor old guys have a straw to grasp. Thanks N3RF for faxing me news of the fusion conference where they are looking hopefully to fuse deuterium with helium-3 (^3He) to make lithium. The only drawbacks seem to be the cost of deuterium, which ain't cheap, and the lack of ^3He. Hey, no problem! It turns out that there's tons of ^3He on the moon. So they're working on plans to ship helium back from the moon. Now that's a great Alice In Wonderland project and well worthy of our federal welfare scientists.

Yes, we do have a serious need to find a new energy source. Our fossil fuels are going to run out within a hundred years and there seems to be some small element of guilt about doing that to our grandchildren. And fission does generate some awful byproducts, for which we have no good plans other than to dump them on our grandchildren and let them worry about it.

Meanwhile, Japan has increased their national investment in cold fusion research from \$7.5 to \$100 million a year! Indeed, I'm getting most of my papers for *Cold Fusion* magazine from Japanese researchers. Our Department Of Energy is still doing its very best to prevent any American research in this field, while pouring billions into hot fusion research via a few chosen universities. Another testament to lobbying power on congress. When can

I get you to sign on to the new NRA? That's Never Re-elect Anyone! Please help flush that stinking Washington toilet you've let clog up.

We're doing pretty well, considering. We're on track to use up hundreds of millions of years worth of fossil fuels in around 150 years. My great-great grandfathers were alive 150 years ago. My father was around when the first cars got going. And I remember my family's Model T. It looks as if my grandchildren will see coal, oil and gas as rare, expensive resources. Wiped out in a cosmic blink of the eye.

Fluoridation - II

In my February editorial I reviewed a book on the dangers of fluoridation. Well, there's poor old Wayne, crying about the sky falling again, right? Maybe you shouldn't bet your life on it. Hey, I thought I was wrong once, but I found out that I was in error.

Yes, fluoride does help children's teeth. But what about the downside toxic effects the ingestion of this poison has, such as hardening of the arteries, increased brittleness of the bones, and the effects on the brain? A recent study from the Department of Toxicology, Forsyth Research Institute, the Department of Pediatric Dentistry, Eastman Dental Center and Veterinary Diagnostic Laboratory, Iowa State University have confirmed the public health malpractice and quackery many doctors have been concerned about for years.

The report cites Chinese scientists who found that a fluoride dose of only 3-11 parts per million (ppm) could effect the nervous system directly. This is well within the amount of fluoride millions of us are getting in our municipal water supplies. Add to that fluoride in toothpaste and mouth rinses, and in our cola drinks, commercial beverages, dietary supplements and even in everyday food.

Another Chinese study showed that fluoride affects our attention spans. American researchers had to make do with rats for their experiments, but they found that fluorides caused behavioral disruption in rats. Prenatal exposure caused cognitive thinking and drug-induced types of behavioral defects. Worse, they now suspect that fluorides, possibly in conjunction with aluminum, could be the root cause for the recent enormous increase in Alzheimer's disease. Right now about one old person in three can look forward to that horror!

The study concluded that fluoride levels acceptable to health departments and dental organizations can cause motor dysfunction, IQ deficits and learning difficulties in humans. Just what we need to add to our worst in the developed world school system and endless child debraining via television.

What to do? Avoid fluoride toothpastes, drink only certified fluoride-free bottled, or better yet, distilled water, put filters on your showers (call 800-728-2288), and get busy starting a political action group...or joining one, if you've got one already. Oh yes, one more thing, if it's too much trouble for you to avoid fluoridated water, then please stay the hell off 20m. We have far too many addled brains on there already. And, one more thing, better start looking around for the nursing home of your choice for when Alzheimer's sets in and turns you into a veggie.

If you think I'm exaggerating, look it up in Vol. 17, #2 1995, *Neurotoxicology and Teratology*. Well, at least get the book I recommended in February. If you've thrown the issue out you can send $3 for my list of "books you're crazy if you don't read."

I got tired of spending 79¢ a gallon for distilled water and bought a small still from Damark ($200). Then I lower the surface tension so my body will better absorb it with Flanagan's Crystal Energy. Wetter water. I suppose I should become a distributor for that stuff. One teaspoon per gallon of water is all it takes. Eddie Albert is using about six times as much in his drinking water and swears by it.

Whither cold fusion?

1995 was one heck of a year for the cold fusion people. In addition to cold fusion conferences in Boston (MIT), Monaco, Bombay, Tokyo, Sochi (Russia) and Molise (Italy), there were some demonstrations of cold fusion cells as a fusion conference at the University of Illinois, and another at Power Gen in Anaheim, where the heads of power companies saw their worst fears confirmed.

Cold fusion first popped up in 1989 when Professors Pons and Fleischmann of the University of Utah announced that when they passed an electric current through a lithium and deuterium electrolyte with a palladium cathode, after a while the cell started generating a whole lot more heat, by thousands of times, than could be accounted for by any known chemical reaction.

The media jumped on this new energy source with headlines.

The chemists and physicists were skeptical. Cold fusion? Ridiculous! Impossible. So they went to their labs, pulled out an old chunk of palladium from a drawer, and tried it out. Nothing happened, so they called in the reporters for their 15-minutes in the news. The fact that most of the universities checking out the cold fusion reaction had millions to lose if they lost funding for their hot fusion work I'm sure didn't affect their diligence one whit.

The head of the DOE published a book on "Cold Fusion, The Fiasco of the Century."

Meanwhile several laboratories did confirm the P&F reaction, but they found it required a very good grade of palladium and days to weeks for the excess heat reaction to start.

Word of the successes leaked out, despite the refusal of any scientific journals to publish any submitted papers or the Patent Office to even look at patent applications. Perpetual motion rubbish.

So the work on cold fusion progressed mainly in Japan as new hydrogen energy, and in Russia, India and Italy. Pons and Fleischmann were so angry over their humiliation that, when a branch of Toyota came along and offered to build them the laboratory of their dreams anywhere in the world, they ended up with a $25m lab on the French Riviera.

The reality

How real is the dream of a non-polluting new energy source that can provide power at less than 10% the cost of fossil fuels such as coal, oil and gasoline? And what will something like this do to the world economy?

One inventor, Dr. Patterson of Sarasota (FL) came up with a new approach to cold fusion. He made microspheres of plastic and then flash coated them with palladium in order to provide a maximum of surface area per unit volume. With hundreds of these tiny spheres in a lithium solution in plain water instead of the more expensive deuterium used by P&F, in April, at the 5th International Cold Fusion Conference in Monaco, his cell was demonstrated producing up to 600% more heat out than the energy required to trigger the reaction.

By October at a University of Illinois fusion conference his demonstration was putting out over 100 watts of heat with only one watt of drive. Scientists from 35 countries checked the instrumentation.

In December, at the Power Gen conference in Anaheim, a scaled-up version of the cell was demonstrated, just in case there were any questions about whether a larger version would work. This cell generated 1,300 watts of heat with but 1.4 watts of drive! This created quite a storm and resulted in a flurry of power company subscriptions to my *Cold Fusion* magazine.

Indeed, there seem to be no major problems to scaling the system up for megawatts of power or down to power wrist-watches. But we're still just barely out of year one when it comes to practical cold fusion power.

There is a need for much more research. Experimenters will be testing various metals such as nickel, rhodium, rubidium, platinum and combinations of them. They'll be testing various electrolytes, temperatures, pressures, excitation voltages, frequencies, RF assistance at the hydrogen and other frequencies, vibration at various frequencies and so on. We're in a scientific no-man's land here, so most of the work is empirical.

The theory

In fact I've been getting more and more papers submitted for publication in *Cold Fusion* proposing explanations for why the cold fusion reaction is turning out so much anomalous heat. The physics establishment hates the whole business since it's "impossible." At first they said that everyone claiming to have produced excess heat had made stupid experimental errors. "They're all mistaken." Why? Because the current standard model for the atom doesn't permit it.

When I first got involved in all this I didn't know anything more about muons and leptons than you probably do. What I did know was that here was another new technology that needed some support to bring it from a laboratory curiosity into a new industry. So two years ago I started reading and asking endless dumb questions, just as I had done back in 1975 when the first microcomputer kit was announced. And in 1983 when the compact disc was introduced. And when I got interested in ham teletype in 1949, and then repeaters in 1969.

Hey, I haven't done anything you couldn't have done, if you'd made the effort. It has little to do with brains, and if you are using that excuse I suggest you invite yourself to a local Mensa meeting and find out how little big brains do for most people. No, it's just plain hard work. That's the prescription Edison gave when they asked him about genius. 99% perspiration and 1% inspiration.

So I've read a pile of books, but coming at the field from a new direction, I haven't been so totally tied down by the work of past geniuses, who may or may not have been right. There's something to be said for starting dumb. Since I have no ego tied up in needing to be right in this new field, I shrugged and proposed my model for the atom. In formulating my model I drew upon a new model for how the solar system evolved as proposed by Eric Lerner. This also explains to formation of galaxies, and even, on the next level of abstraction, why we have super-galaxies. I also drew on the 1908 book by Besant and Leadbeater on their clairvoyant visions of atoms.

Can I explain how an atom is made up in simple language? Of course.

We know from blowing atoms apart in super-colliders that they're made up of quarks. And quarks are made up of sub-quarks. And we know that all of this stuff has spin. Now, please picture a sub-quark made up of a small ball of energy. It probably looks something like a ball of yarn, with the energy that makes it up spinning around the ball, rising to the top, zipping down the middle in a tight vortex, out the bottom, and around maybe seven times again and fwoop down the vortex again.

These little energy balls are held together by the suction of the energy in the vortex. But this also tends to attract nearby balls of energy.

Think of quarks being made up of strings of these little spinning balls, which in turn make a larger spinning quark.

You may not have delved into physics far enough to know that scientists have had no good explanation for inertia. Nor have they had a reasonable explanation for why we have gravity. Einstein proposed gravity as being the result of the deformation of the space-time continuum. Sure.

Now let's suppose we have a box full of spinning gyroscopes. If we try to push the box, the gyroscopes are going to resist, right? And once you start them moving they're going to tend to continue to move in the same direction. Voilà, you have inertia.

The collective attraction of these energy balls for one another we sense as gravity.

I've proposed this theory in my *Cold Fusion* editorials, fully expecting to be dumped

on for being so dumb. A couple of scientists have called, naming the energy balls "Green Balls." Well, at least they didn't suggest Green's Big Balls. But though the readership of the publication includes some of the world's top physicists, no one has dumped on me yet. They probably will.

Why cold fusion?

Not satisfied with going way out on a limb with my proposed solutions for inertia and gravity, I've been reading more books, looking for clues to what's happening to produce all that heat. The power of the vortices in my little energy balls could explain how the dread Coulomb barrier is overcome. This is a force that keeps two protons apart.

In my January editorial I had a section on alchemy today, recommending the book, "The Philosopher's Stone." Well, the more I thought about it, the more likely it seemed to me that what was happening in the cold fusion cells was hydrogen changing to helium, though lab tests have confirmed that not enough helium is produced to explain all of the heat generated. Okay, perhaps the lithium in the electrolyte is combining with two hydrogens to form beryllium and/or with four hydrogens to form boron. And why not also check and see if the palladium is combining with two hydrogens to form silver? It won't hurt to check for sodium too, which might be the result of lithium combining with one oxygen. Or palladium with oxygen to produce antimony. The universities of Illinois and Missouri are checking some used cell microspheres with mass spectrometers to see if there are signs of element transmutation. I'll be surprised and disappointed if they don't find I'm right on what's happening.

Each of these proposed transmutations would tend to release heat, easily explaining the excess heat generated by the reaction.

The media

The first sign of serious media attention to the recent cold fusion developments was the airing of a segment on Dr. Patterson on "Good Morning America." This was followed that evening on "Nightline" by a full half hour devoted to the Patterson cell. The main critic of cold fusion has been Prof. Huezinga of the University of Rochester, who put his scientific reputation on the line by publishing a book, "Cold Fusion, the Fiasco of the Century." The poor professor, faced with Dr. Patterson's success, sat there with his eyes closed or blinking most of the time, apparently wanting to hide, and stuttering about there being no detected radioactive products, so it couldn't be fusion. No, since it was impossible, he hadn't bothered to look into it. Figures.

Cover Photos

If you're handy with a camera, show me what you can do—let's see some interesting photos I might be able to use on the cover. Sure, antennas can be fascinating, and a hamshack with a zillion dollars worth of equipment can make us envious, so I'm not discouraging the tried and true. But that just tends to make *73* like the other ham rags, and we're *not*.

As old Uncle Don used to say, "Let's put on our thinking caps." You remember Uncle Don, right? Every night for years on the Mutual Network at 6 pm. Of course, he's better known today for something else he said. Anyway, let's see what you can

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Debunking Some Myths

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9. Impedance mismatches cause power reflections on the feedline. Assuming a loss-less feedline, a) all reflected power will be returned to and radiated by the antenna, and b) all received signal power will be returned to the receiver. However, if a mismatch between the receiver and feedline exists, the reflected signal power will be returned and re-radiated by the antenna.

10. High SWR in a coaxial transmission line does not create RF currents to flow on the surface of the outer braid. When the currents are of equal amplitude, even open-wire feedline will not radiate due to high SWR. The currents must remain balanced.

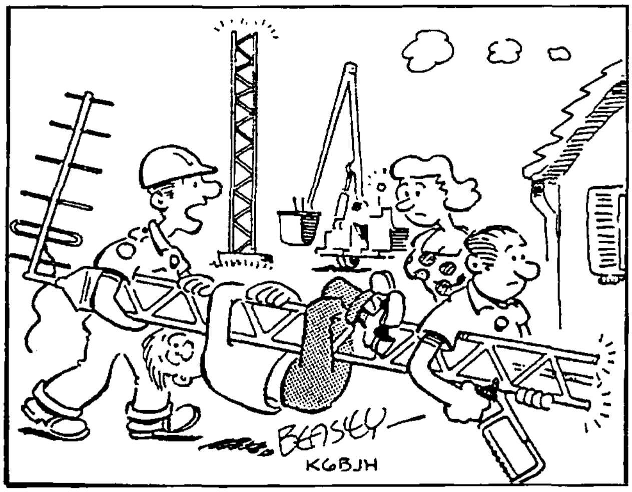
11. Loading coils (used to shorten antennas) provide the necessary inductive reactance to cancel the capacitive reactance. It is very easy, and very wrong, to believe that the coil is replacing the missing "length."

12. Using a balun transformer to transform (change) impedances to a transmitting antenna is often desirable. However, the balun must be operated within its power rating, or the ferrite core material may become saturated. A heated balun is the result of wasted, non-radiated RF energy.

13. A big antenna does not radiate more power than a small antenna. However, large antennas do confine the radiation into a much more directional pattern than a small antenna. The larger antennas, due to the concentrated directional capability, also receive or capture more signal than the smaller antennas.

14. When using a frequency meter to find the resonant frequency of an antenna, the meter should be connected at the antenna. Connecting the meter after a length of feedline measures the resonant frequency of the combination.

While it is fun to discuss antenna systems, we all need to make a conscious effort not to propagate falsehood—one operator was overheard telling another radio operator that his transmission line must have a 1:1 SWR because it lay perfectly flat on the ground and didn't have any bumps in it. I think he may have been equating impedance bumps to speed bumps!



Toon 3: *Sorry about the tower, ma'am—we couldn't pry your husband loose.*

Continued on page 88

Reprinted from the March 1967 issue of 73 Amateur Radio.

Edison—The Fabulous Drone

by J.L. Elkhorne

Was Edison really the great genius schoolbooks tell us he was? Or was he simply very diligent and hardworking?

The Great Man confided that he tried "everything" while working on inventions. When 10,000 experiments with a storage battery went down to failure, he said: "I have not failed. I have just found 10,000 ways that won't work."

He argued with Nikola Tesla, the brilliant Serbian engineer and scientist, telling him that AC electricity was a "waste of effort and money."

"Looks like a bunch of Chinese laundry markings," he remarked of his hired mathematicians' worksheets.

He said: "Genius is one percent inspiration and 99 per cent perspiration."

Most people think Thomas Alva Edison was perhaps the world's greatest inventor. But in comparison to his contemporaries, he was an inveterate fiddler, who scorned abstract work to tinker about with one failure after another.

Tesla observed of Edison's work methods: "If Edison had a needle to find in a haystack, he would proceed at once with the diligence of the bee to examine straw after straw until he found the object of his search." Tesla said further: "I was a sorry witness of such doings, knowing that a little theory and calculation would have saved him ninety per cent of his labor." Edison plodded along, content to improve on existing ideas, insistent on hand work over brain work, and often completely blind to the uses of his own great and original work. Of his first phonograph, he said: "Maybe we could use it for some sort of telephone repeater."

In later years he said of its first successful test: "I was never so taken aback in all my life. Everybody was astonished. *I was always afraid of things that worked the first time.*"

Even after patent rights were issued to manufacturers, Edison claimed it was "just a fad, and would be completely forgotten in five years." As late as 1925 he would not concede that electronic phonographs were superior and maintained that T.A. Edison, Inc. would make an improved mechanical phonograph for long playing records.

Also in 1925 he noted that the 'radio craze' would soon pass. "The present radio...is certainly a lemon. It will in time cure the dealer of any desire to handle any kind of radio." He also insisted that the public would not stand still for having to listen to the programming the broadcasters provided.

In 1926, though very hard of hearing, Edison tested an electronic phonograph perfected by Bertil Hauffman, a Swedish engineer, at the Edison Laboratory. Edison found the reproduction 'distorted and terrible' and ordered that Hauffman be fired. Son Theodore, director of the works, arranged for Hauffman to work thereafter in a part of the laboratory that Edison was not likely to visit.

Edison once said that he enjoyed his deafness because it permitted him to concentrate. Though his progressive deafness made him almost stone deaf in elder years, one wonders if the affliction also allowed him to ignore criticism in earlier times.

Another facet of the Edison myth is the famous story of his sleeping only four hours a night. John J. O'Neill reports in his biography of Tesla: "It was a regular practice with Edison to sit down in his laboratory and doze off into a three-hour nap about twice a day."

Edison was strangely averse to theoretical work himself; as a thinker, he was second rate—as an administrator, second to none. The 'Wizard of Menlo Park' hired batteries of mathematicians and physicists, laughed at their theoretical approach, but utilized their results.

When the young genius Nikola Tesla came to this country, he had a letter of introduction to Thomas Edison, four cents in his pockets, and the key to alternating current electricity—today's housepower—locked in his mind. Edison offered him a meager eighteen dollars a week, providing he never spoke of AC.

Tesla proved himself an able engineer and inventor, regularly submitting improvements for Edison equipment. When Tesla suggested research toward improved dynamo manufacture, Edison told him: "There's fifty thousand dollars for you in it—if it works." Inside the week, Tesla presented the design. When he finally had to ask about the money, Edison grinned and said: "I guess you just don't understand our Yankee humor."

Tesla quit. Some months later, he had interested investors in his ideas for AC, constructed working models, and applied for a patent. The U.S. Patent Office responded that the ideas contained in the original patent application were so far-reaching that no less than forty would cover them!

George Westinghouse, industrialist and inventor himself, offered Tesla one million dollars for the rights and the Westinghouse Electric Company was formed. This was prologue to the biggest battle of the 19th century: a technological war in which Thomas Alva Edison was the prime antagonist.

Edison had recently spent two million dollars with his DC system in New York City. The financial threat posed by Westinghouse and Tesla could not be ignored. Although Edison had said AC was "a waste of effort and money," he found his system impractical to produce voltages higher than 220, as the dynamo commutators heated badly. Too, line losses necessitated either large, expensive conductors or power stations spaced every mile or so.

DC power left the generating plant at about 120 volts. the users closest to the plant had the brightest lights, sometimes so much so that bulbs burned out frequently. Conversely. those at the end of the line had light hardly better than candlepower. because of the voltage drop along the line. With Tesla's AC system. alternating current could be transmitted equally to home or factory. with negligible power loss in the lines.

Edison wrote: "Just as certain as death Westinghouse will kill a customer within six months after he puts in a system of any size...it will never be free from danger."

Westinghouse argued that of thirty deaths by electricity in 'recent' years. sixteen were from 'safe' DC circuits. and none from Westinghouse equipment. During one period Edison lost about a workman a month with 'safe' direct current and almost burned down the fashionable Vanderbilt home on Fifth Ave. A fire started when metallic-threaded draperies shorted out the wiring which had been placed behind it. Mrs. Vanderbilt returned home to find a confusion of firemen. assistants and Edison himself. Learning that there was a generating plant in her cellar. she became 'hysterical' and declared she could not live over a boiler. "We had to take the whole thing out," Edison ruefully remarked.

To sway public opinion in the "battle of the currents," Edison and Charles Batchellor—ironically the man who gave Tesla the letter of introduction to Edison—demonstrated the horrible danger of alternating currents by electrocuting cats and dogs. using a one kilovolt generator. They paid eager schoolboys twenty-five cents a head for all the animals they could deliver. It is said that the house pet population around West Orange stood in danger of being annihilated. During one of these edifying illustrations for guests. Batchellor lost his hold on the dog he was about to electrify and himself received the shock. As he put it later: "The sensation was of an immense rough file thrust through the quivering fibers of the body."

After this. Edison published an article saying in part: "I have not failed to seek practical demonstration...I have taken life—not human life—in the belief that the end justifies the means." Yet in the final battle of this strange war. Edison seemingly reversed his opinions and requested permission to install AC equipment in upstate New York. Westinghouse hastily agreed.

It might be said that the news of the installation came as a shock to Westinghouse—it was the first electric chair. The New York State Legislature had adopted a statute in 1888 to provide for capital punishment by electrocution. H. P. Brown. a former research expert for Edison. supervised the installation of the 'hot squat' for the Edison General Electric Company.

On August 6. 1890. convicted murderer William Kemmler was to be executed. The first attempt at death by legal electrocution was a failure. as the electric force was too weak. The unfortunate man was led away. After quick modifications to the chair, "The miserable work was perforce done again, resulting in a spectacle much worse than hanging."

A frantic Westinghouse recouped by obtaining the contract to provide power for the Columbian Exposition of 1893. Tesla had his own exhibit there. where he mystified fairgoers with his scientific marvels. The climax of the many performances was the passing of one million volts of AC through his body to melt a copper plate. It was not high voltage that killed. he maintained. but the destructive heating of high currents. High amperage DC could and did kill as readily as AC. While working up his demonstrations. he discovered the medical principle of diathermy.

The public was won over to AC and in 1895. Tesla harnessed Niagara Falls. His powerhouse was completed. providing AC for Buffalo. New York. twenty-two miles away. It was hailed as the greatest engineering achievement in the world to that date.

In 1896. a mysterious cigar-shaped airship was seen by hundreds of people over San Francisco Bay. and subsequently was reported in successive eastward sightings. A New York *Herald* reporter obtained this statement from Edison. who disclaimed any knowledge of the never-identified craft: "I prefer to devote my time to objects of commercial value. At best airships would only be toys." A few years later. he was congratulating Alberto Santos-Dumont for inventing powered flight. not recognizing the achievement of the Wright brothers.

The Edison Effect—the expulsion of particles from a heated filament—grew from experiments with the light bulb. Edison found that bulb life was shortened by the deposit of carbon from the filament. He sketched in his notebook the first two-element vacuum tube as a solution to the problem, having found that current would flow into the second element. This forerunner of today's diode was patented but never used, and the patent lapsed.

With the diode, his discovery of the 'etheric force' and a subsequent patent of wireless transmission based on electrostatic induction. he had in his grasp the elements of a complete radio system several years before Hertz demonstrated the existence of radio waves. Later in life, he said that it was a pity he had not seen any connection between them.

His first major invention. the carbon button microphone. is virtually the same today; it improved an existing idea. the Bell device. Edison came, as it were, into a technological vacuum, purifying existing and imperfect concepts, and applying much of the random electrical science accumulated over fifty years. He did enough that he could well say in later years his productivity brought him "awards by the quart." He patented over 1.100 inventions and gained a vast reputation while his more brilliant and less understood contemporaries are all but forgotten.

George Westinghouse himself patented over 400 inventions in his lifetime and founded 60 companies.

Charles Proteus Steinmetz, whom Edison liked "because he never spoke of mathematics to me," published the law of hysteresis when he was only 27. went on to produce artificial lightning and delve into higher mysteries. He is little known today.

Nikola Tesla. besides giving the world AC. demonstrated radio control before the turn of the century, developed a working system of broadcast power, lighted his laboratories with wireless fluorescent lights in 1889, and had over 700 patents to his credit when he died in 1943. Yet he is the forgotten man of electrical science.

Edison. the Great Man, reigns supreme.

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

APR 6

AIKEN, SC The Aiken Contest Club will sponsor the 2nd Annual Aiken Hamfest and Computer Show at Aiken County Jaycee Fairgrounds. US Hwy. 1 North. 4 mi. South of I-20. Doors open Sat. at 9 AM. Set up Fri., 6 PM–9 PM; Sat., 6 AM–9 AM. VE Exams, Reg. at 10 AM–Noon at the Jaycee Hut. Testing at 12 Noon. Walk-ins only, bring original and copy of your license, any CSCE's, and 2 ID's, 1 w/photo. There will also be a used gear test table. Talk-In on 147.285(+), 145.170(-) and 443.400 (+, 107.2 Hz). Contact *Doug Glass AC4WW, 127 Trailwood Ave., Aiken SC 29803-7602. Tel. (803) 648-4754.*

LONGMONT, CO The Longmont ARC will sponsor its Annual LARCFEST at the Boulder County Fairgrounds, Hover and Nelson Rds., 8 AM–3 PM. VE Exams at 1 PM. Talk-In on 147.27/.87, and 146.52. Write with SASE to *LARCFEST, L.A.R.C., P.O. Box 86, Longmont CO 80502-0086.*

APR 12–13

TUPELO, MS The Tupelo ARC and Booneville ARC will sponsor the Northeast Mississippi Hamfest and Computer Expo on Apr. 12th, 6 PM–9 PM, and Apr. 13th, 8 AM–5 PM, at the Tupelo Furniture Market Complex, Coley Rd. Flea Market. VE Exams. Contact *Jack Ellis KI5QV, Rt. 4, Box 198-B, Tupelo MS 38801. Tel. (601) 842-7255.* Talk-In on 147.38(+); Ragchew on 147.24(+).

APR 13

CENTRAL VALLEY, NY The supporters of the Northeast Connection are scheduling a major Fox Hunt, to be held at multiple locations in Orange County. The first three hunters to locate the fox will receive a valuable prize. All other participants will receive certificates of appreciation. You need not be a supporter of Northeast Connection to participate. For more details contact *Sid KB2RNQ, or write to P.O. Box 551, Central Valley NY 10917.*

FREDERICKSBURG, PA The Appalachian AARG will hold their 8th Annual Hamfest and Computer Show at Northern Lebanon H.S., beginning at 8 AM. VE Exams on-site, pre-reg. requested; contact *Roger Engle WN3U, 981 Radio Rd., Elizabethtown PA 17022. Tel. (717) 367-2230.* For tables, contact *AARG, 105 Walnut St., Pine Grove PA 17963, Tel. (717) 345-3780; or Lanny Hoffman KD3TS, 337 N. 19th St., Lebanon PA 17042. Tel. (717) 274-2148.*

APR 14

BRIGHTON, CO The Aurora Rptr. Assn. will hold its 14th Annual Swapfest at the Adams County Fairgrounds, 9755 Henderson Rd., 8:30 AM–2 PM. Contact *Judi WDØHNP, (303) 450-6910;* or *Jan KA7TYU, (303) 699-1944;* or write to *Aurora Repeater Assn., P.O. Box 39666, Denver CO 80239.*

FRAMINGHAM, MA The Framingham ARA will host its Spring Flea Market and Exams at Framingham H.S., A Street. Doors open for buyers 9 AM–1 PM. Set up is at 8 AM. To reserve tables, contact *Martin Bayes AA1ON, (508) 435-0564,* and send check payable to FARA, to *FARA, P.O. Box 3005, Framingham MA 01701.* To register for exams, send a check for $6.05, payable to ARRL/VEC, to *Dick Marshall WA1KUG, 37 Lyman Rd., Framingham MA 01701.* Exam walk-ins will *not* be accepted after 10 AM. Talk-in on 147.15 Rptr.

MADISON, WI The Madison Swapfest and Computer Fair, sponsored by Madison Area Rptr. Assn. WB9AER, will be held starting at 8 AM at Dane County Expo Exhibition Hall. Talk-in on 147.15 Rptr. Sellers and exhibitors w/ 6 or more tables set up at 3 AM. All other sellers set up at 6 AM. Exhibitors, contact *MARA*. 24 hr. answering machine, *(608) 245-8890.* Make reservations before April 6th. Make checks payable to MARA, and mail to *MARA, Box 8890, Madison WI 53708-8890.*

RALEIGH, NC The Raleigh ARS will present its 24th Hamfest, ARRL NC State Convention and Computer Fair in the Jim Graham Bldg., NCS Fairgrounds, Sun., 8 AM–4 PM. All activities indoors. VE Exams, pre-reg., (919) 847-8512. Dealers, contact *Rollin Ransom NF4P, 1421 Parks Village Rd., Zebulon NC 27597. Tel. (919) 269-4406.* Talk-In on 146.04/.64.

APR 19–21

VISALIA, CA The 1996 Internat'l DX Convention will be hosted by the Southern Calif. DX Club, and held at the Visalia Holiday Inn. Reg. includes two hosted Cocktail Parties, Sat. Banquet, Sun. Breakfast, all programs, etc. For more info, contact *Rick Samoian WB6OKK, (714) 993-0713.* Send registration requests/ payments to *Don Bostrom N6IC, 4447 Atoll Ave., Sherman Oaks CA 91423.*

APR 21

ARTHUR, IL The Moultrie AR Klub will hold their 34th Annual Hamfest at the Moultrie/Douglas County Fair Grounds. 8 AM–1 PM. Flea Market. Forums. Talk-In on 146.055/.655 and 449.275/ 444.275. Contact *M.A.R.K, P.O. Box 91, Lovington IL 61937. Tel. days, (217) 543-2178; eves., (217) 873-5287.*

BOOTHWYN, PA The Penn-Del ARC will hold their Annual Hamfest 8 AM–2 PM at the Nur Temple on Route 13 in New Castle DE. Set up at 6 AM. No advance tickets. Tables by reservation only, with payment to *Penn-Dell Hamfest 96, P.O. Box 1964, Boothwyn PA 19061.* Certified Skywarn Spotter Training Class, ARRL Forum at 11 AM. Contact *Hal Frantz KA3TWG, (302) 798-7270.*

SONOMA, CA The Valley of the Moon ARC, WB6DWY, will hold its Annual ARRL Hamfest 8 AM–3 PM at the Sonoma Veteran's Memorial Bldg., 126 First St. West. Walk-in VE Exams, reg. at 9 AM, tests at 10 AM. Electronics Swap Meet, set up at 7 AM. Forum will include an operating QRP station and display of home-built equip; an AMSAT booth w/operating Earth station; a beginner's Fox Hunt, and more. Station WB6DWY will operate on 20 and 40 meters at 7045, 7250 and 14250 MHz (+/-) during the Hamfest. QSLs can be sent to *Darrel Jones WD6BOR, 358 Patten St., Sonoma CA 95476.* Please include an SASE. Talk-In on 145.35(-) PL 88.5. For info, call *Darrel WD6BOR at (707) 996-4494.*

APR 27

DES MOINES, IA A Hamfest will be held by the Des Moines Radio Amateur Assn. at Iowa State Fairgrounds Tourism Bldg., 8 AM–1 PM. Talk-In on 146.94. VE Exams. Contact *Duane Bower WBOUCY, 207 Diehl Ave., Des Moines IA 50315. Tel. (515) 287-6542* after 5 PM.

FLATWOODS, WV The 3rd Annual Central WV Hamfest, sponsored by the Pioneer ARA will be held 9 AM–3 PM at Braxton County H.S. Motels available. Dealers welcome. Talk-In on 145.29, 146.655. Contact *Ed Messenger N8OYY, (304) 462-5312;* or *Vic Moyers N8MJQ. (304) 462-7885;* or write to *PARA/HAMFEST, P.O. Box 301, Glenville WV 26351.*

HURON, SD The Huron ARC will sponor their 3rd Annual Amateur Electronics Swapfest 8 AM–3 PM at the Nat'l. Guard Armory, SD State Fairgrounds. Flea Market set up at 7 AM. VE Exams at 9 AM. Talk-In on 146.22/.82. Contact *Lloyd Timperley WBØULX, P.O. box 205, Huron SD 57350. Tel. (605) 352-7896* eves.

SYRACUSE, NY The Liverpool Amateur Rptr. Club will hold a Hamfest at New York State Fairgrounds 7:30 AM–4 PM. Demos, Flea Market, Exhibits. Talk-In on 146.91(-). Contact *Larry Taft AA2KK (315) 668-8219* eves; or *LARC, P.O. Box 103, N. Syracuse NY 13212; or N2TKX@AOL.COM.*

APR 27–28

MONROE COUNTY, MI The Radio Active Comm. Club of SE MI, and the Maumee Valley Monitoring Assn., will host their 1st annual weekend of Transmitter Hunting, in the Monroe area. Local participants should contact *Mark N8IQX at (313) 582-0896* for info and reg. Out-of-towners, please send an SASE to *Mark Drolias, 15104 Prospect, Dearborn MI 48126.*

APR 28

ATHENS, OH The 17th Annual Hamfest of the Athens County ARA will be held 8 AM–3 PM at the City Rec. Center. Take the East St. exit from US Rte 33 or US Rte 50. Indoor space by advance reg. only; contact *Drew McDaniel W8MHV, 61 Briarwood Dr., Athens OH 45701. Tel. (614) 592-2106, 6 PM–9 PM EST; Internet: dmcdaniel1@ohiou.edu.* For general info, write to *Carl J. Denbow KA8JXG, 63 Morris Ave., Athens OH 45701-1939; Internet: cdenbow1@ohiou.edu; or packet: KA8JXG@KA8DRR.OH.US.NA.* Talk-In on the Club Rptr. at 145.15(-).

CHICAGO, IL The Chicago ARC will present a Ham Auction at the DeVry Inst. of Tech., 330 N. Campbell Ave.,

starting at 12 Noon. All items auctioned are subject to a 10% donation. If purchased back by seller, then 5% will be due. Bring TVs, VCRs, 2-way radios, oscilloscopes, meters, signal generators, transmitters, receivers, transceivers, amplifiers, tuners, antique radios, etc. For more info, call *Dean at (708) 331-7764*, morning or eve. During the day, call *George, (312) 545-3622*.

GROSSE POINTE WOODS, MI The SE Michigan ARA will conduct its 34th Annual Hamfest/Swap-N-Shop/ Computer Show at Grosse Pointe North H.S., 707 Vernier Rd., 8 AM–2 PM. ARRL Forum. VE Exams. Talk-In on the SEMARA Rptr, 146.74(-). Contact *Thomas Orlicki N8HLY, P.O. Box 646, St. Clair Shores MI 48080-0646. Tel. (313) 527-3497. E-mail: STOSH@NVISION.COM.*

MAY 4

ETOBICOKE, ONT., CANADA The Annual Spring Hamfest and Flea Market sponsored by the Skywide ARC will be held at Westway United Church, 8 Templar Dr., 9 AM–1:30 PM. Vendors set up at 8 AM. Talk-In on 146.985 or simplex 146.52. For info, call *Derrick Poulter VE3ZXD, (416) 243-2020*; or *Went Wheatley VE3WAY, (416) 233-6648*.

MAY 4–5

ABILENE, TX The Key City ARC will sponsor the ARRL West Texas Section Convention and Hamfest at the Abilene Civic Center, 8 AM–5 PM Sat., and 9 AM–2 PM Sun. VE Exams. Pre-reg. must be received by Apr. 30th. Talk-In on 146.160/760. For info and reservations, contact *Peg Richard KA4UPA, 1442 Lakeside Dr., Abilene TX 79602. Tel. (915) 672-8889.*

MAY 5

SANDWICH, IL The Kishwaukee ARC Hamfest '96 will be held at Sandwich Fairgrounds, starting at 8 AM. Set up at 6 AM. Talk-In on 146.730(-) Rptr.; 146.52 simplex. Advance tickets $5, tables $10. Make checks payable to KARC, and SASE to *Howard WA9TXW, Attn: Hamfest, P.O. Box 264, Sycamore IL 60178.*

YONKERS, NY A Giant Electronic Flea Market will be held at Lincoln H.S. by the Metro 70cm. Network. Time: 9 AM–3 PM, rain or shine. Set ups at 7 AM. VE Exams. Talk-In on 449.425 MHz PL 156.7; 223.760 MHz PL 67.0; 146.910 Hz; and 443.350 MHz PL 156.7. CAll *Otto Supliski WB2SLQ, (914) 969-1053.* Mail paid reservations to *Metro 70 CM Network, 53 Hayward St., Yonkers NY 10704.*

MAY 11

MANITOWOC, WI The Manitowoc County Expo Ctr. is the chosen site for Mancorad Radio Club's1996 Hamfest and Computer Swapfest. The event starts at 8 AM. Flea Market (amateur, computer, electronic). VE Exams at Silver Lake College (Hwy. 151); test reg. closes at 9 AM. Camping (414) 683-4378. Dealer set up Fri. night till 10 PM, or early Sat. morning. Talk-In on 146.01/.61 or 147.03(+). Contact: SASE to *Mancorad RC, P.O. Box 204, Manitowoc WI 54221-0204*; or call *Red, (414) 684-9097 days; or Glenn, (414) 684-7096*, any time.

SPECIAL EVENT STATIONS

APR 1–30

DAYTON, OH The Farout ARC will operate WB8SMC 0001 UTC Apr. 1st–2359 UTC Apr. 30th. to commemorate the Bicentennial of the founding of Dayton OH. Freq.: 25 kHz up from lower Gen./Nov. PH/CW band edges (op's choice). For a QSL card, send an SASE to *Charlie Cotterman, c/o WB8SMC. 26 Mello Ave., Dayton OH 45410-2119.*

APR 6–7

PISCATAWAY, NJ The Piscataway ARC will operate member stations, signing /VOA, from 0000Z–2400Z each of the two days. It will commemorate the World War II operation of the "Voice of America" relay station, WBOU. Freq.: CW–Novice portions of the bands; Phone–lower third of the General portion of the 75–15 meter bands and the Novice portion of the 10 meter band. RTTY operations on 80, 40, and 20 meters. For a certificate, send QSL and SASE to the station worked.

APR 14

OTTAWA, ONT., CANADA The Ottawa Valley Mobile RC will operate an SE Station to celebrate the 1st Anniversary of the opening of the amateur radio station/exhibit at the Museum of Science and Tech. Freq.: SSB–3860, 7260, 14260, and 147.300(+) FM, depending +/- QRM. Times are 1400Z–2200Z (0900–1700 local). For your choice of a certificate or QSL card, send an SASE to *VE3JW, Box 5530, Stn 'F', Ottawa ONT, Canada K2C 3MI.*

APR 14–27

TOFIELD, ALBERTA, CANADA Special Event Station VA6SG will operate to celebrate the 4th Annual Snow Goose Festival. Freq: SSB–160, 80, 40, 20, 15, 10 meters, and 146.52 FM (Talk-In Freq.). *QSL via VE6WPY CB*. Address including two green stamps or three IRCs to cover postage. Allow 6 weeks for delivery of certificate.

APR 20–21

AMERICUS, GA The Sumter Co. ARC will operate W4UFD 1400Z–2000Z each day, to celebrate Charles Lindburgh Day. Freq.: 7.250, 14.303, 21.305. For a QSL, send QSL and SASE to *C.T. Royal WD4EIK, P.O. Box 195, Americus GA 31709.*

APR 21

SONOMA, CA The Valley of the Moon ARC will operate WB6DWY, 1700 UTC–2200 UTC to commemorate the City of Sonoma and the Valley of the Moon's rich historical heritage. The station will operate in conjunction with the Valley of the Moon ARC's annual ARRL Hamfest. Operation will be on 20 and 40 meters at 7045, 7250, and 14250 MHZ (+/-) during the Hamfest. QSL to *VOMARC, 358 Patten St., Sonoma CA 95476.* Send an SASE for the event Certificate.

APR 26–27

THOMASVILLE, GA The Thomasville ARC will operate W4UCJ 1700Z–2300Z Apr. 26th, and 1100Z–2000Z Apr. 27th, to commemorate the 75th Annual Rose Festival. Operation will be in the lower portion of the General 60, 40, 20 and 15 meter phone subbands, and the Novice 10 meter phone subband. For a certificate, send QSL and a 9" x 12" SASE to *TARC/Rose Festival Station, P.O. Box 251, Thomasville GA 31799.*

APR 27–28

GREEN VALLEY, AZ The Green Valley (AZ) ARC will operate W7PU 1600Z Apr. 27th–2300Z Apr. 28th at the Green Valley Titan Missile Museum, a Historical Nat'l. Monument. Operation will be on 3.860, 7.230, 14.250, 21.330, 28.450 and 145.290/144.69. For a certificate, send QSL and a 9" x 12" SASE to *GVARC, 601 N La Cañada, Green Valley AZ 85614.*

MAY 3–5

MARSHFIELD, MA The Whitman ARC will operate K2BSA/1 at the Old Colony Council Boy Scout Camporee from May 3rd at 1200 hrs.–May 5th at 1200 hrs, on 14.285 and 18.140 +/- QRM. Please, all QSL replys *must* be sent with an SASE to the *Whitman ARC, P.O. Box 48, Whitman MA 02382.*

MAY 4-5

GENOA, CO The Ten-Ten Internat'l Contest will sponsor their CW QSO Party May 4th and 5th. For a complete set of rules, sample log sheet and sample dupe sheet, send a #10 SASE to *Don Zielinski KØPVI, 10-X Intl. Contest Manager, c/o The Bighorn Museum of Amateur Radio, P.O. Box DX, Genoa CO 80818-0119.* 73

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure It still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the June 1996 classified ad section is April 12, 1996.

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

April is expected to provide some very interesting conditions for DXers. The Poorest days (P) are expected to be the 8th and 21st–22nd. The Best days (G) are expected to be the 1st, 4th–5th, and 25th–27th. The 10th–13th, 16th–17th, and 29th are expected to provide only Fair (F) conditions, while the remaining days should be trending, as shown on the chart. Sunspot activity may also be increasing with the imminent onset of Cycle 23.

Intermittent daytime thunderstorms will provide the occasional QRN to wipe out weak signals just when you need confirmation of a report or call sign! However, you'll note that Good, Fair, Fair-to-Good, and Good-to-Fair conditions should be present on 23 days, leaving only 7 days to worry about. You should be able to score big-time DX in April, particularly in view of the overall seasonal improvement in solar flux levels. Good luck!

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

'here 10m is shown, also check 12m. Where 15m is shown, check 17m o. Where 20m is shown, be sure to look at 17 as well. Always check the unds above and below the indicated bands for possible openings to the eas shown. Remember that DX is where you find it, and not always 'iere it is predicted to be.

10–12m

Occasional trans-equatorial F-2 layer openings during daylight hours, with 12 meters to show greater signal strengths.

15–17m

Circuits from the northern hemisphere to Africa and South America should open on *good* days, and daytime short-skip openings will also be present on *good* days. Performance of these bands will be sporadic, but on some days will sparkle.

20m

This will be your most consistent band of choice for DX opportunities from sunrise until after sunset. Expect DX from northern to southern hemispheres with decent signal strengths on most days, and short-skip openings to 2,000 miles as well.

30–40m

DX from just before sunset until shortly after sunrise will provide enjoyment on the *good* days. However, be aware of seasonal QRN interfering with weak signals. Signals peak to the east before midnight and peak to the west before dawn. Daytime short-skip will be good out to 1,000 miles or so.

80 and 160m

DX during hours of darkness will be available, but not as prevalent as during the winter months. QRN may become a problem for weak signal reception. Some daylight short-skip on 80 will be present, but none at all on 160. 73

April 1996

SUN	MON	TUE	WED	THU	FRI	SAT
	1 G	2 G-F	3 F-G	4 G	5 G	6 G-F
7 F-P	8 P	9 P-F	10 F	11 F	12 F	13 F
14 F-G	15 G-F	16 F	17 F	18 F-G	19 G-F	20 F-P
21 P	22 P	23 P-F	24 F-G	25 G	26 G	27 G
28 G-F	29 F	30 F-G				

Number 88 on your Feedback card

UPDATES

Sunrayce

Oops!

We hope you enjoyed "Satellites, Weather Imagery, and Sunrayce '95" by James R. Buchanan K8WPI. We do have a couple of things to clear up—the specter mentioned on page 10 was Rod *Serling*, not Sterling; (##25) should have been (>25); and the 2 wavelengths at which the author tailgated the tractor-trailer should actually have been .2; quite a difference in anxiety ratio there!

IMPORTANT SAFETY NOTICE

Alert reader Calvin Hashi N6SSW sends this warning of possible Fire Hazard:

In "Simple Mobile Protection" published in January's *73* the author states "...the relay I used is one commonly used in mobile two-way radio installations." He adds "I've seen similar relays for sale at auto accessory shops as horn-relay replacements."

DO NOT USE HORN-RELAY REPLACEMENTS!

In Calvin's own words, "A horn-relay is designed for an intermittent (not continuous) duty-cycle. A few years ago, I tried to use a horn-relay for continuous duty, only to have it overheat (the relay actually started smoking). A much better choice (for about $5.00) would be to use a 20–amp continuous-duty relay that is used for auxiliary automotive lamps (like fog lights) that you might find in a four-wheel drive accessory shop. *The important thing is to use a relay that has a continuous current rating of 20 amps or more.*

We join Calvin N6SSW in hoping no one's car has caught fire because of a horn-relay!

Authors Please Note

Superscripts and symbols often become garbled in electronic transfer. Please send a hard copy for reference along with your electronic submissions. (FAX is 603-924-8613.) TNX from 73 editorial staff.

NEVER SAY DIE

Continued from page 81

do in the way of some creative ideas for the *73* covers. Surprise me.

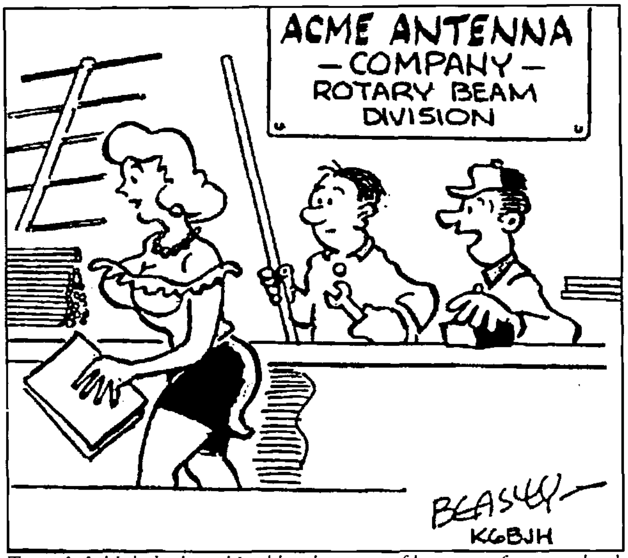
When you're planning the shot I hope you'll remember that the cover is vertically polarized, in case you've missed noticing it. And don't forget to leave some unimportant (picturewise) space along the top for the magazine logo and space for a few article teasers somewhere.

Yes, of course, despite the incredible fame your amazingly creative photo will achieve, I will still manage to eke out some reward money. And just to make sure your fellow hams will be in proper awe of your genius, I'll include your photo and credit on the table of contents page.

One note: the family dog with earphones, sitting at your ham rig and captioned "CW Hound," will not the mustard cut. Another note: 35mm, if you use a tripod, can hack it, but you'll get much better results with a 6x7 cm camera. 73

Debunking Some Myths

Continued from page 81



Toon 4: *I think the boss hired her because of her great front-to-back ratio...*

Including Ham Radio Fun!

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73 Amateur Radio Today

International Edition

Can hams help cure AIDS?

See page 10

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Transmitter Hunting Equipment
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Ten Tec SS-11
T-Kit 2m Amp. Kit

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MAY 1996
ISSUE #428

73® Amateur Radio Today

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HAM RADIO FUN SECTION

On the cover: QSL Card Contest Winners: January, KG6JY; February, W6DDB & W6JEP; March, KE5TC; April, 3A2MD & K3IVO. Thanks for all the entries which are still contenders for future months' contests. The prizes are CD's.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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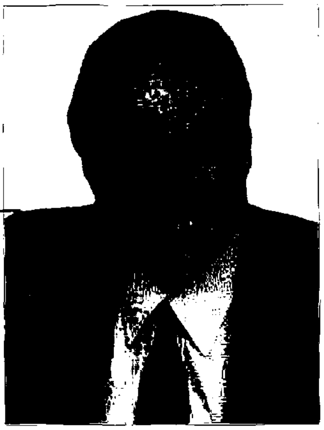
Contract: Even the most cursory glance at this text is sufficient to bind you, morally and legally, to take a kid (or kids) along on Field Day, get 'em fired up on amateur radio, and then help 'em get started toward a license. You'll feel good about yourself and our legal cousel won't have to hassle you.

Number 1 on your Feedback card

NEVER SAY DIE



Wayne Green W2NSD/1

Well, here we go with another of Wayne's editorials...starting off with a call for you to get elected to your state legislature—to help save amateur radio, if nothing else. Then I start teaching Making Money 101. I push (again) for you to give outstanding hams recognition before they die of poor nutrition and dehydration like the rest of us. I'll bring you up to date on the exciting recent cold fusion developments, plus some ideas on biological transmutation. Stuff like that.

I really should stop taking showers! That's when all of my better ideas hit. And this morning's brainstorm is a corker. It's a way we can turn our hobby into a national movement.

I've been fussing at you for years about getting youngsters back into the hobby, endlessly griping about how our beloved ARRL, then controlled by millionaire Mort Kahn W2KR, wiped out 95% of the school radio clubs 30 years ago, destroying the infrastructure which had been feeding hams into our hobby for the 17 years after World War II. Indeed, school radio clubs provided 80% of our newcomers up until 1964, and we had a steady 11% growth per year. Just thought I'd remind my Alzheimer's readers.

How would you like to help to not just keep amateur radio alive for the next generation, but to help make it grow again? How would you, at the same time, like to help a few million youngsters have a better chance at high-paying high-tech jobs? We hams, more than most people, know how important it is to understand the fundamentals of electronics and communications.

The electronic genie has been let out of the bottle and no amount of protectionism is going to stop the changes it's making in the world. Cellular phones, faxes, a new generation of personal communicators, computer networks, beepers, and so on have changed how business is run. Low cost communications and transportation has put workers almost anywhere in the world in direct competition for many of our jobs.

Our manufacturing plants are in competition with those in Korea and Pakistan, where their wages are not only a fraction of ours, but their educational systems are vastly better, and their degree of automation is enough to scare the hell out of any American manufacturer. I've written about a Korean factory I visited that turns out color TV sets by the millions. It is so totally automated that their labor per set is under 15 minutes, including packing and shipping!

More than ever before, it's either work smart or you don't work. Computers and communications are thinning the administrative ranks as well as the factory work forces. Most machines are now numerically controlled, with robots replacing workers without demanding vacations, sick pay, health insurance, unemployment insurance, coffee breaks, smoking breaks, or overtime.

I hope it is no news flash for you, but our worse-than-Third-World school system is *not* preparing our kids to cope with technology. And that's where *you* come in.

Yes, I know, the country is being run by politicians whose foresight is limited to their next reelection campaign. But that's not only a problem, it's one hell of an opportunity. And, with few exceptions (I hope), our politicians are being controlled by their major campaign donors. And that ain't us. The whole existence of amateur radio today depends on our being invisible instead of on what we're contributing to society.

Okay, here we are with around 700,000 licensed hams. That's a pretty good group to work with, but only if we can get 'em all headed in the same direction.

The plan

One of the biggest favors we amateurs could do for our states, our country, and our hobby, would be to get an eight-year course in electronics, communications, and computers into every grade school in the country. And I'll tell you exactly how we can do it, if you're game.

The key is to start locally and work upward. It doesn't cost a lot to run for the state legislature. What kind of an impact could we have if only 1% of the hams could get elected to state legislatures? That's 7,000. I don't think there are that many state legislators. Here in New Hampshire we have the largest state legislature in the country, with 400 representatives. Now that's local representation! But then New Hampshire is such a small state that I know all of my senators and representatives personally. And the governor. The president of the University of New Hampshire has been a good friend for over 35 years. And so on.

The main promise you can make to the voters is that you are going to work to improve our school system. By getting our kids a better education we'll help them make better incomes and be more able to compete with workers anywhere in the world. An eight-year course (grades 5-12) in technology isn't going to solve every educational problem, but it'll probably be better than any other single change we could make. If you can get the ball rolling in your state, we'll see this becoming a national movement. This isn't something that can be organized by Washington bureaucrats. This has to start locally.

Of course, one of the r oblems in teaching electronics is the speed of change. By the time a new textbook can be produced and accepted it's two or three generations of chips behind. Teaching kids 1990 technology in 1996 is stupid. The simple and logical answer to that is a monthly magazine for each of the eight grades. It would cover the material for the month, have a special encyclopedic section on one specific technology, and columns on high-tech hobbies such as ham radio, computer hacking, science fairs, and so on. The idea would be not only to teach the kids, but to get them personally involved so they would enjoy learning and go out of their way to learn as much as they could.

But, you probably argue, if you are a true-blue negative thinker, a magazine like that would cost around $25 a year per student and that might be prohibitive for many low income families. So how about allowing advertising to pay the freight? Would you really be upset if Sears, Nike, et al helped make a world-class education possible for your kids? Or grandkids?

I'll bet there would be a bunch of electronic and other science kits advertised too. Heck, with enough advertising, each issue could include a small parts kit or a CD-ROM. We might be able to wean the next generation away from Nintendo and TV.

A course like this would get a lot of kids interested in science, bringing us many more scientists and engineers. If we're going to get back our consumer electronics industries from Japan we're going to need 'em. Of course, we're only losing a few tens of billions of dollars in revenues, so who cares, right?

And I have a sneaky plan for making it possible for colleges to run tuition-free, without government or even alumni subsidization. And they'd graduate kids in three years instead of four, learning maybe double or triple what today's grads do. As a legislator you'll be in a position

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LETTERS

From the Ham Shack

Eleanor Schlan K6LGZ. You asked about good public speakers. I heard Jerry Freeman K9AAH, who just retired from the FCC. He gave a *fantastic* talk to our ham group.

You're right! I've known Jerry for 30 years or so, and he's got a wealth of great FCC-ham stories to draw on...Wayne.

Guy A Matzinger KB7PNQ. The hobby of amateur radio is showing some classic symptoms of hypersensitivity to suggestions that code testing speeds should be eliminated or reduced to not more than 5 wpm. The latest drumbeat from pro-code advocates who adamantly oppose the relaxation of Morse code tests is, "Standards will fall." Test speeds of 5, 13, and 20 wpm could be considered standard speeds for test purposes, but how does the day-to-day operation of anyone's station tie into these undefined standards? Even the FCC avoids defining their standards. Western Union had a minimum code speed (standard) for their telegraphy operators— so did the Armed Services. Amateur radio is not a private activity or a professional telegraphy service and those using CW should be able to operate at their own speed. Why, then, are 13 and 20 wpm code tests jammed down amateurs' throats?

Pro-code advocates expend enormous amounts of ego-driven energy with their self-centered views that those who cannot demonstrate "high speed code proficiency" should not be entitled to enjoy the hobby and, with bureaucratic pandering, they have put up legal barriers to limit participation. These rampant egos, with their lingering "standards" paranoia and their total disregard for technical advancements, make it impossible for mature amateurs to respect any organization that contends they represent amateur interests. Fearlessly soliciting meaningful feedback from the majority of amateurs, not just from those who have convinced themselves that limiting participation is a virtue, will drive improvements and, with rational collaboration, will create the future of the hobby. Political action will then achieve results that support the desires of the majority—perhaps in a manner similar to that which changed apartheid—with or without approval of hard-line opponents.

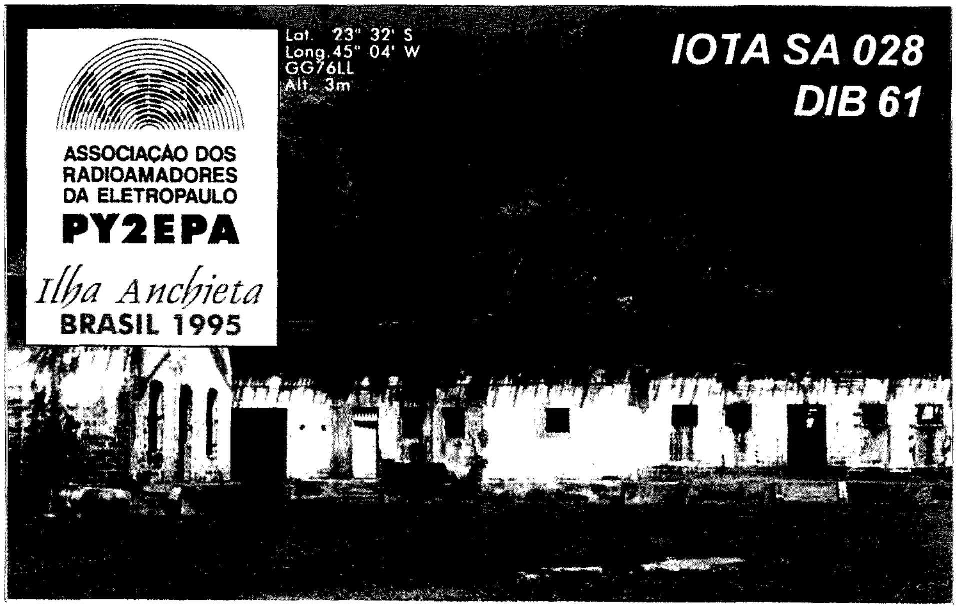
Radio spectrum is owned by the citizens of this country and both the use of that spectrum and amateur licenses are subsidized by taxpayers. Most counties charge amateurs annual licensing fees, but pro-code advocates contend that amateur operators are entitled to these "freebies" because of the "services" rendered to the community. This delusion is constantly being generated by those who want something for nothing. Occasionally some public service may be provided, but, as police from across the country have reported, cell phones are the preferred choice for emergency communications.

The constant babble that this is a technical hobby may have had some merit 60 years ago, but considering the "plug and play" technology of today's equipment, anyone who can read can assemble the necessary components to operate an amateur station. It is doubtful that 1% (7000+) of the amateur population constructs their own equipment or makes significant modifications to existing gear. The majority of amateurs are not even interested in how—technically speaking—their hardware achieves results. Continuing technological improvements can't be stopped, but improved operating could, and should, be provided to ensure an enjoyable hobby experience for the majority of amateurs.

Current testing practices no longer facilitate the society of amateur radio operators. Old ways may have been adequate years ago, but, to survive in the future, amateur radio must face the reality of today's communications technology and be responsive to the innovations and ingenuity that, even now, is evolving around the world. Recognizing the need to change is essential for any activity that wishes to avoid obsolescence—and just fading away.

Troublemaker...Wayne

Carlos Carneiro PY1CC. Here's the QSL that was sent to the stations who contacted ZW2EPA on Ilha Anchieta during a four-day DXpedition. It's a small island about five miles off the coast of São Paulo. It was once run by pirates, then by slave traders, next it was a prison, and now it's a park run by the Forrest Institute for tourists. The operators were PY2CL, PP5LL, PY2PA, PY2AH, PY2EVW, PY2FAR, and PU2NMA. The QSLs are handled by PY2YW. The best band was 15m, where almost 900 contacts were made. And almost 600 on 20m. Well, band conditions were poor. It's not a new country, but it was a new island for the Islands Of The Air (IOTA) and Brazilian Islands Awards (DIB).



Walter Rawle VE1AWS/W5. The article Crystal "Controlled Audio Generator" by J. Frank Brumbaugh KB4ZGC, Nov. 1995, issue 422, was very well done except for a significant flaw in the schematic diagram. C11, the output coupling for the Q3 emitter follower stage, is connected to the positive supply rail. The accompanying text indicates that the Q3 stage output is connected to the Q2 mixer stage. This error motivates an interesting question: Does the mixer work better with both signals applied to the base with the transistor driven into saturation, or does the mixer work better with one signal applied to the base and the other signal applied to the emitter with the transistor operating in its linear region? It would be beneficial to have the author reply on this item.

On a second topic, I would be interested in reading your opinion on what I refer to as the "high price" of ham radio equipment. Despite the avalanching price of RF components resulting from the upward swing in the commercial wireless industry, ham radio equipment prices remain at levels consistent with those five years ago. As an RF engineer working for a company involved in the commercial spread spectrum systems market, I

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Number 8 on your Feedback card

QRX . . .

Four Days In May — The QRP Event of 1996

QRP Amateur Radio Club, International (QRP-ARCI) proudly announces the first annual QRP Symposium to be held on Thursday, May 16 1995 - the first day of four festive days of 1996 Dayton Hamvention QRP activities. Mark your calendars and get your hotel reservations in early for this not-to-be missed QRP event of the year.

Conference presentations, meetings and workshops on everything you wanted to know about amateur radio QRP will all be part of this full day Thursday event to be held at the Days Inn Dayton South (513-847-8422). QRP-ARCI Symposium attendees will start their day with a wake-up coffee social and then plunge into a morning of multimedia QRP presentations by renowned QRPers and QRP equipment manufacturers. A short break for a catered lunch and some special QRP door prizes and then back to an afternoon of more exciting QRP technical presentations. And if that is not enough, then come join us for a Thursday evening of QRP break-out session tutorials. The 1996 QRP-ARCI Symposium will be the talk of the Dayton Hamvention.

QRP-ARCI continues the "Four Days in May" QRP extravaganza with nightly hospitality suite sessions, where QRP projects from around the world are displayed with a pride that only a QRPer could appreciate. "Four Days in May" QRP-ARCI week culminates with the annual QRP-ARCI Friday Night Banquet honoring QRP dignitaries for their service to the amateur radio community.

Registration for the QRP Symposium will be $30 if prepaid by May 1, 1996 and $35 if paid after that date or at the door. Please send your $30 (US check, money order) QRP Symposium Registration fee made out to Paulette Quick, N9OUH at the address below.

Paulette Quick, N9OUH, Registration Chairman (plquick@facstaff.wisc.edu): P.O. Box 145, Madison WI 53701-0145: (608) 263-9326 (work phone)

Happy Birthday 6 Meters

An important anniversary took place in March of 1996—it marked fifty years that US radio amateurs have been on 6 meters. This means that other than the WARC bands of 10, 18 and 24 MHz, 6 meters is one of the newer Amateur Radio bands. It remains as one of our most interesting ham bands and is seeing rapid growth in several areas of the world.

U.S. amateurs were first assigned the 6 meter band in March of 1946, when they were moved off the 5 meter (56MHz) band. This reallocation took place in order to accommodate a new block of VHF TV channels by the FCC. There was little commercial gear available at that time, so many hams on 6 meters homebrewed their own 6 meter gear. During the 1950s and 1960s, commercial gear that could be converted for 6 meter, AM operation was manufactured. Six meter AM was thought of as a good local communication mode for line-of-sight work. In addition, it was used as part of the Civil Defense emergency network by hams involved in public service. Six meters was particularly popular with the Technician Class hams and this led to the label "Technician's band." From L'Anse Creuse Amateur Radio Club newsletter.

Computers vs. Automobiles

Here's a quote from Robert Cringley, "InfoWorld", "If the automobile had followed the same development as the computer, a Rolls-Royce would today cost $100, get a million miles per gallon, and explode once a year killing everyone inside."

HamVention Forum News

The forums at the 1996 Dayton HamVention will continue the tradition of offering more information than you could ever absorb in three short days, but you're up to the challenge, right?

On Friday there will be a special presentation on the role amateur radio played in the aftermath of the Oklahoma City bombing, along with presentations on AMSAT, TAPR Digital Radio, Antennas, Using Ham Radio in the Classroom, County Hunters, and the Electrical Safety Demo.

On Saturday, things get really busy because several forums from Friday and Sunday have been switched to allow improvement in the facilities. Some of you may have experienced the limitations of Room 7 during the last few years. You'll be pleased to know that Room 7 has been eliminated. Arrangements have been made for three forum rooms at the Meadowdale High School, which is located just a half mile from HARA. MHS is where the alternative activities are held, along with the license exams, and is regularly served by free buses. This year, there are seven forums scheduled at MHS on Saturday only, and bus coverage has been beefed up to assure that those who want to attend the forums at MHS will have the quickest trip that we can provide, both coming and going. The forums at MHS include: Combined QRP, Media and Ham Radio, Firebirds, Operating Techniques for New Hams, International Hungarian ARC, OSSBN, and Logging Programs. The alternate activities, including a luncheon, and the license exams will also be at MHS on Saturday.

Saturday has always been the big day for forums at HamVention, and it may take some planning to get to all of the ones that interest you. Forums at HARA include: DX, Contesting, MARS, Amplitude Modulation, YLRL, Amateur Radio and the Internet, Weather Satellites, Gerltol Net, SSTV, ATV, ARES, Youth in Amateur Radio, PACTOR, Direction Finding, VHF/UHF/Microwave, Digital Digest, AMSAT, Tech Talks, and the Electrical Safety Demonstration.

Then on Sunday the choices include: FCC, ARRL, Amateur Radio and the Law, Amateur Radio Repeater Operation, Mobile Radio Installation Tips, 10-10 Electrical Safety Demo.

There is so much to take in just from the forums you might be tempted to skip the vendors and the flea market! *From the RF-Carrier, DARA.*

JY1: Strong on MidEast Peace

On the international scene, Jordan's King Hussein JY1, is in the news once again. His Majesty was in Washington in March, where he joined the U.S.-led battle to prevent a wave of terrorist bombings in Israel from destroying chances for peace in the Middle East. In a meeting on Thursday, March 14th, with President Bill Clinton, the King said the bombings, which have killed 57 people, were the work of a small group acting against an overwhelming majority of people in the Middle East who are seeking a lasting peace.

According to several newspaper reports, King Hussein's powerful words helped to strengthen a United States-led drive to isolate the militants behind the bombing campaign and keep the Middle East peace process alive.

While JY1 has condemned the bombings previously, his presence at the White House alongside President Clinton gives a much higher profile to his own anti-terror stand.

Vanity, Vanity...

If you are wondering why the vanity callsign program is still on hold, look to some of your fellow hams for the answer. Several are still petitioning the FCC for last-minute changes in the program. Those petitions, coupled with a mandate from Congress to implement the Telecommunications Rewrite Act, have put vanity calls on hold at least until mid-year.

Still awaiting FCC action are Petitions for Reconsideration filed last fall by Charnelle H. Summers W4IJE; David B. Popkin W2CC; Robert Nelson, on behalf of the Hill Country Amateur Radio Club; and Christine M. Gill, on behalf of the Southern California Repeater and Remote Base Association.

As noted, it appears as if the FCC will not even begin to look at any of these petitions until early this summer. How long after that it will take to dispose of them is not known. And there is always the possibility that more Petitions for Reconsideration could arrive. By law, each must be addressed.

Even worse, some of the current crop of petitioners might take their cause further if the commission does not give them a decision favorable to a given position. This means appeals before the full Commission and maybe even taking the matter into federal court, if they have the money and the desire to do so.

Meantime, the FCC vanity callsign application Form 610V is now available, but the FCC will not accept completed forms until the appropriate filing gates are opened.

TNX Bill Pasternak WA6ITF, Amateur Radio Newsline producer & editor

Build the Bioelectrifier

Heal yourself and take a poke at the medical establishment at the same time!

Thomas M. Miller WA8YKN
314 South 9th Street
Richmond IN 47374

One of the first things a new amateur learns is that electricity and biology are not very compatible. A brush with the AC line can be a painful experience, and accidental contact with the high-voltage supply of a large transmitting tube can be fatal. Because of this early training, occasionally reinforced by an unpleasant accidental jolt, it might surprise some hams that tiny electrical currents can be beneficial to the human body.

For some time, doctors have known that passing a small current through a broken bone will cause it to heal faster. Damaged tendons and nerves also seem to respond to this treatment. Exactly why this works is not known, although a doctor once explained to me that it seemed to focus the body's attention on the area.

Recently, doctors at the Albert Einstein College of Medicine reported discovering that passing a current of only 50 microamps through the blood can prevent certain viruses, notably the HIV virus, from replicating. The current became even more effective when the polarity was reversed several times a second. The implications are enormous.

Unfortunately, there has been very little interest in this phenomenon by the medical community. Those of us who read Wayne Green's editorials have become aware of a simple device which introduces a small electrical current through the legs by placing electrodes on the ankles. Since the arteries in the legs are large, and the blood has less electrical resistance than the surrounding tissue, this technique results in most of the current flowing through the blood. This is an ideal approach for amateur experimentation, since it is totally external, and the required voltage and current levels are so tiny as to pose no danger. I decided to design such a device, using a simple printed circuit board, and easily obtained parts, so that it could be duplicated by other amateurs.

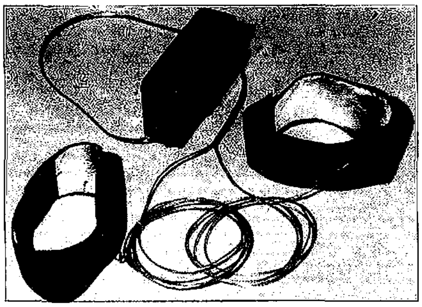


Photo A. The Bioelectrifier with belt clip and ankle electrodes.

At this point, let me state that I make no medical claims for this device. To paraphrase a famous Chief Medical Officer, I'm an engineer, not a doctor. Since very few doctors are electronics experts, there are many who would love to research the possibilities of this approach to eliminating vires in the blood, but are unable to build the needed experimental device. They need your help.

So I present this circuit for those wishing to help doctors experiment in an unknown field, and also as an interesting study in design and construction.

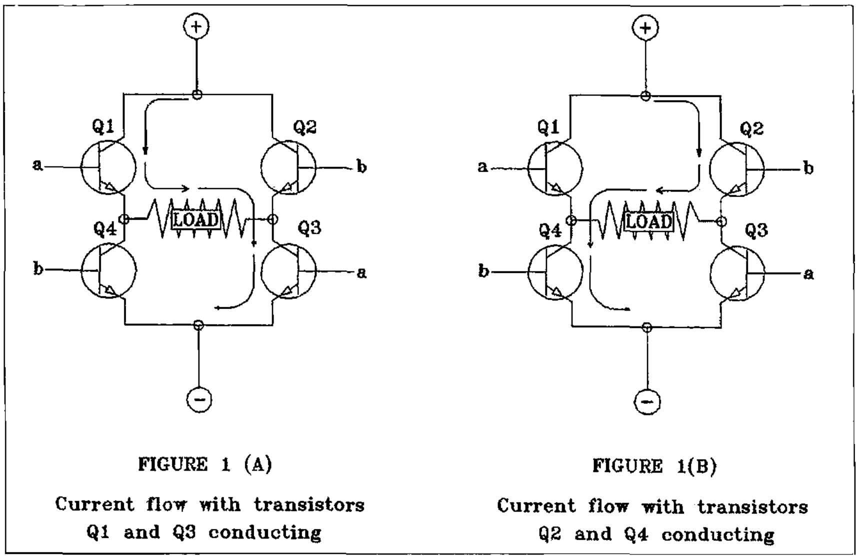


Fig. 1. Four transistors are used to reverse the current flow by energizing them in pairs.

Designing a Bioelectrifier

Before attempting to design any device, it's a good idea to make a list of goals. In this case, it's a simple list:

(1) The device should produce a current flow of 50 microamps from one ankle to the other. Experimentation has shown that this requires 30 to 35 volts.

(2) It must be capable of reversing the current flow several times per second. This rate should be adjustable.

(3) It must be all solid-state—no DPDT relays clacking away, eating up the batteries.

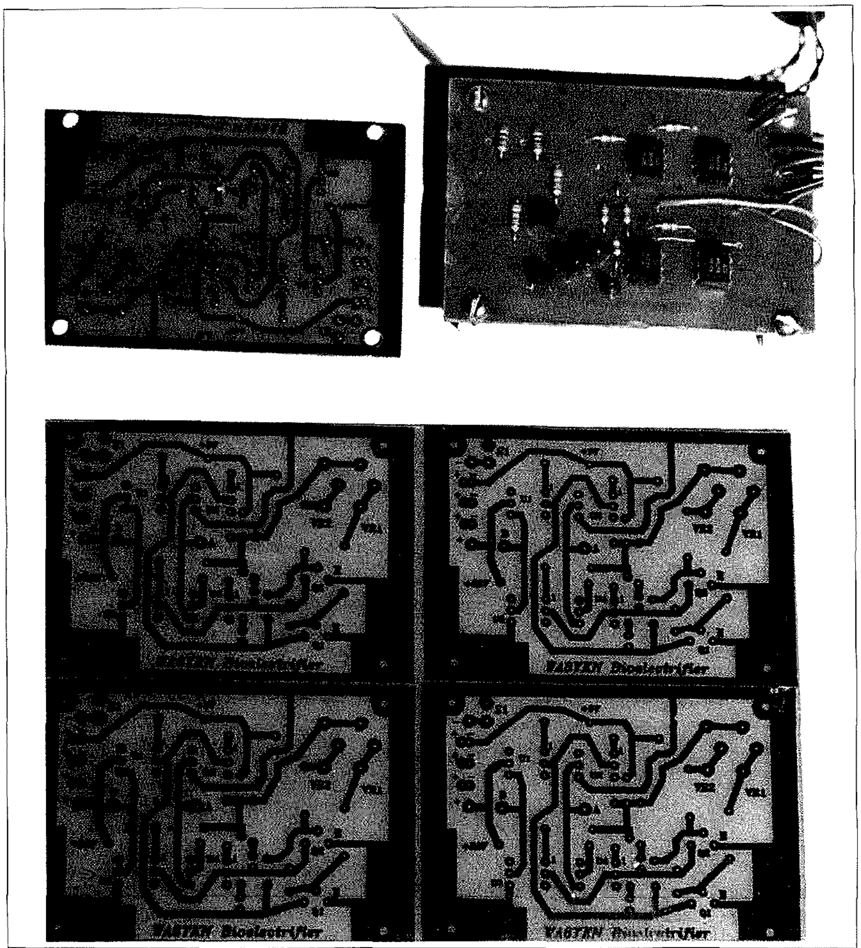


Photo B. Four circuit boards are etched on a single piece of copperclad and are cut apart after drilling.

(4) It must be small, light, and easy to carry. The ideal form would look like a pocket pager.

(5) It must have a low current drain for long life from small batteries.

(6) It must be as simple and inexpensive as possible, so that it may be easily reproduced.

This last goal is one of the most important in designing any device or circuit. It is, in fact, Occam's Razor, a corollary which states that when there are many ways to solve a problem, the best solution is the simplest one.

At first glance, it would be tempting to use logic chips, or perhaps a 555 timer and a flip-flop to get a variable timebase with an equal on-off ratio. However, this direction leads to a regulated power supply, high current drain, and a complex circuit. Also, logic chips will not switch 35 volts without an additional driver stage. Remember rule number six... the simplest way!

Maybe we'd be better off starting from the other end. Reversing polarity requires the solid-state equivalent of the DPDT relay. As it turns out, there is just such a circuit commonly used to drive and reverse DC motors. It uses four transistors in an "H" configuration, the load being in the center (see Fig. 1). When transistors 1 and 3 conduct, the current flows in one direction, while energizing transistors 2 and 4 reverse the flow. Most small switching transistors will stand up to our requirement of 35 volts at 50 microamps, but here we run into a new problem. For each direction, two transistors are in series, with the load in the middle. This creates a difficult bias arrangement to drive both transistor bases equally. Fortunately, there is a neat solution—the optocoupler. This invaluable device contains an LED and a phototransistor in one package. Energizing the LED produces light, which causes the phototransistor to conduct. No base voltage is required, therefore there are no bias requirements. Optocouplers are usually used to drive another device, but our requirements are so small that we can use them as output transistors.

The cheapest optoisolators cost less than a dollar and will withstand over 30 volts with current ratings in the hundreds of milliamps. For a few cents more, optocouplers are available that will withstand 80 volts or more.

With four optocouplers in the output of our device, all that remains is to alternately drive them in pairs. The simplest circuit to accomplish this is the multivibrator—nothing more than two general-purpose transistors, two resistors, and two capacitors. Voltage is not at all critical, and since we will be connecting batteries in series to get 35 volts, we can tap off at the 9 volt point to power the circuit. While we're at it, adding two more resistors and two tiny LEDs will give a visible indication of circuit operation and warn us when the battery goes dead.

Varying the frequency of a multivibrator requires that two resistors be varied

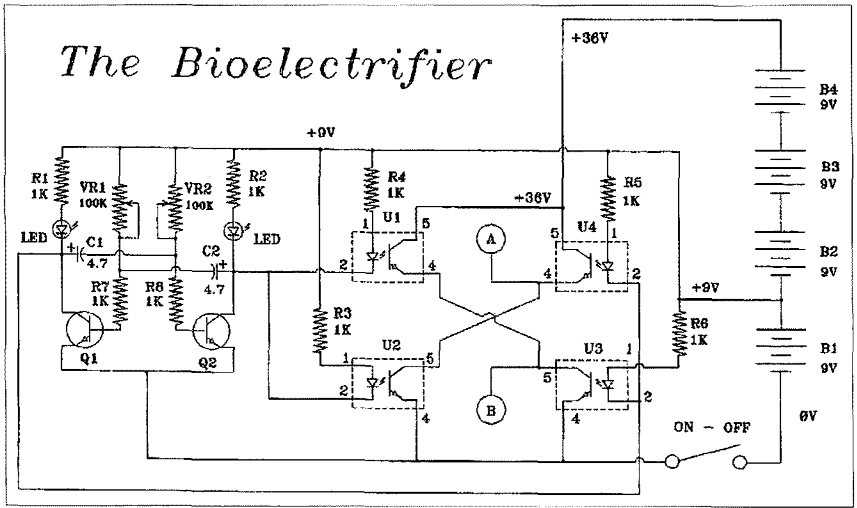


Fig. 2. Schematic diagram of the Bioelectrifier.

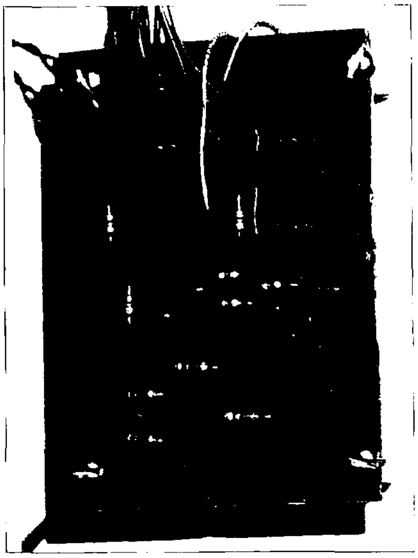


Photo C. The Bioelectrifier – component side of the board.

together...no big deal. Two-gang potentiometers are ideal for this. In fact, our design goals do not specify that an equal duty cycle is required, or even desired. Two trim pots will give independent adjustment of the two states if this is needed. A fixed resistor in series with each pot will establish a maximum frequency limit, preventing the circuit from dropping out of oscillation when the pot is adjusted all the way.

We now have the basis of a simple, practical design: four optocouplers, two transistors, one dual pot, two capacitors, two LEDs, and eight resistors, all of the same value! The schematic diagram is shown in **Fig. 2.** Of course, we will have to add a box, switch, and batteries, and some sort of electrodes. We also need a name. Since we are experimenting in bioelectrics, let's call it the Bioelectrifier!

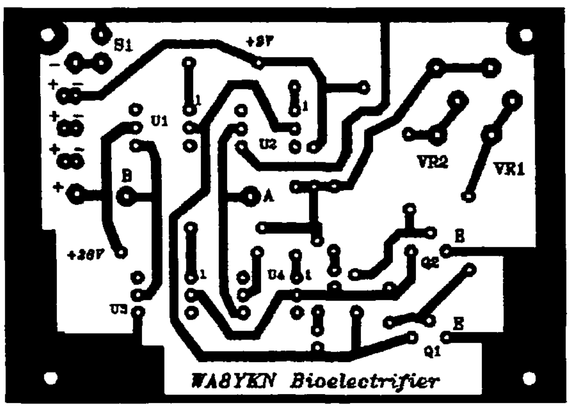


Fig. 3. The circuit board pattern, shown actual size.

The printed circuit board

When designing a printed circuit board for this type of project, a compromise must be made between size and ease of construction. The board should be single-sided with as few jumpers as possible, and there should be enough room for 1/4 watt resistors, in case the smaller 1/8 watt are not available. The final design is shown in **Fig. 3.**

In my work, I design and build a lot of prototype circuits, and I've settled on an easy technique for circuit board fabrication. I use a Computer Aided Design (CAD) program to create the actual pattern, and then use the computer to generate a mirror image. If the board is small, as in this case, I will then copy this mirrored pattern to get the maximum number of circuits from a standard positive pre-sensitized copperclad board. This mirrored array is shown in **Fig. 4.** After printing this pattern, I copy it with a standard copy machine and inspect the copy for places where the toner is less than pure black. These areas, if any, are touched up with a felt-tip marker. When I've got a pattern that will give a good, pure black copy, I run two or three copies to warm up the drum, then make a final copy on clear Mylar, sold in office supply stores for making overhead projector displays. It may be necessary to set the copy machine one step darker than normal, since machines tend to vary in how well they work with Mylar. This copy can be used as a positive for printing the circuit board.

Using a standard (4.5" by 6.5") pre-sensitized board, place the Mylar sheet with the circuit board pattern *toner-side down* on top of the board. (The writing should be correct—not reversed!) Place a piece of glass over the Mylar to hold it in contact with the board, and expose it for three and a half to four minutes using an Ultra Violet sunlamp 12 inches above the board. Be sure to protect your eyes during the exposure!

After the board is exposed, dunk it in the developer until all the copper between the traces is shiny and clean; this usually takes around two minutes, but you really can't overdo it. Rinse the board with cold water, and it's ready to etch.

I etch my boards with ferric chloride solution in a tall, thin plastic tank that allows the board to stand up vertically. The use of an aquarium heater and air pump will cut the etching time in half. Do *not* get the etching solution on anything made of metal—it will corrode badly. It also stains everything, so wear rubber gloves and be careful!

After etching, clean the etch resist from the board, polish with steel wool, and drill the holes. The individual patterns can be cut from the board using a bandsaw, jigsaw, or even by hand with a hacksaw if that's all you have. You now have not one, but four circuit boards ready for construction.

Building the Bioelectrifier

Fig. 5 shows the parts layout for the Bioelectrifier. Be sure to install the optocouplers correctly. Also, the very small LEDs often do not have a flat spot to indicate the cathode, but instead have one lead shorter than the other. Check before cutting the leads! The *long* lead connects to the dropping resistor.

There are two ways that this circuit can be built. For experimentation, the device can be mounted in a larger box, potentiometers used to vary the frequency and current, and perhaps even a microammeter to monitor the current. However, I've discovered that it's not always wise to give a device with many controls to a non-technical person, especially if changing any of the adjustments would nullify the experiment. Also, we want a pocket-sized device, or one that can be clipped to the belt. Once the operating parameters are established, the resistance of the potentiometers can be measured and the pots replaced with fixed resistors (I used 68K). This makes a much smaller package possible, with only a single on/off switch and two tiny LEDs on the outside. I built one in a 2 7/16" by 5 1/16" plastic box (Radio Shack 270-233) and mounted the switch and LEDs in the end. Four 9 volt batteries would not fit in this box, but one 9 volt and two 12 volt "N" batteries will fit with no problem, and produce 33 volts. Radio Shack sells 12 volt alkaline "N" batteries in a package of two, (23-154) and "N" battery holders (270-405).

I made a belt clip from a strip of steel banding material and glued it to the back. I also glued a two-pole terminal strip to the end of the box to connect the electrode leads, although a plug and jack would be fine. I used what I had on hand.

Electrodes for the prototype were simply strips of aluminum foil, folded to form two strips several layers thick, 2 inches wide and 12 inches long. Wrapped around each ankle, the foil was held in place by rolling the socks up over it. Later, a better electrode was made by gluing aluminum foil to strips of cloth-backed vinyl upholstery material, with hook-and-loop fastener material glued to the ends.

In either case, connect two 36-inch lengths of hookup wire to the Bioelectrifier's output terminals, and solder a paper clip to the other end of each wire. Slip one paper clip over each electrode, clip the Bioelectrifier to the patient's belt, and your doctor is ready to go.

OK, it's done. Now what?

Even if your doctor doesn't know anyone with the HIV virus, there are many experiments he can try with the Bioelectrifier. If it works on the HIV virus, what about others, such as those responsible for herpes, Epstein-Barr, colds, and flu? Will a few minutes a day actually *prevent* colds and flu? What effect will different frequencies have? The long-term benefits can only be determined by experimenting and recording the data.

It is interesting to note that all animal life on earth has evolved in the magnetic field of the planet. Blood, being mostly water and containing salts and iron, must generate a tiny voltage as it moves through this field. Is this voltage necessary for good health, and can it be disrupted by exposure to much more intense 60 Hz electromagnetic fields?

I've often wondered, as we think about manned missions to other planets, if we will one day discover that we cannot live for a great length of time without the Earth's magnetic field. So far, only a few people have ever left the planet, and only for a short time. These astronauts, however, have found that after a few days in space, the immune system starts to shut down! No one has yet found a good explanation for this. Perhaps a small application of bioelectrics is in order!

One interesting result reported by Wayne Green was that when his friend Beck used a similar device for two hours a day instead of the usual 20 minutes, just to see if there might be any harmful effects, he started losing weight! The weight loss continued until he reached his normal weight, then stopped. Since, as Wayne has repeatedly noted, many hams appear to be "eleven months pregnant," this could be the biggest thing since FM! Perhaps this device will open new fields of communication. Just adjust the frequency to match the 7 Hz resonant frequency of the Earth and tune your brainwaves to Dr. Jung's Universal Consciousness!

All kidding aside, there have been enough results from experiments to date to warrant serious study, and, as usual, mainstream science will continue to ignore it, while sucking up government funds for expensive and ineffective research. But breaking new ground is the amateur's forte. We have the technical skills and the manpower. Keep in mind that *every* new field is pioneered by

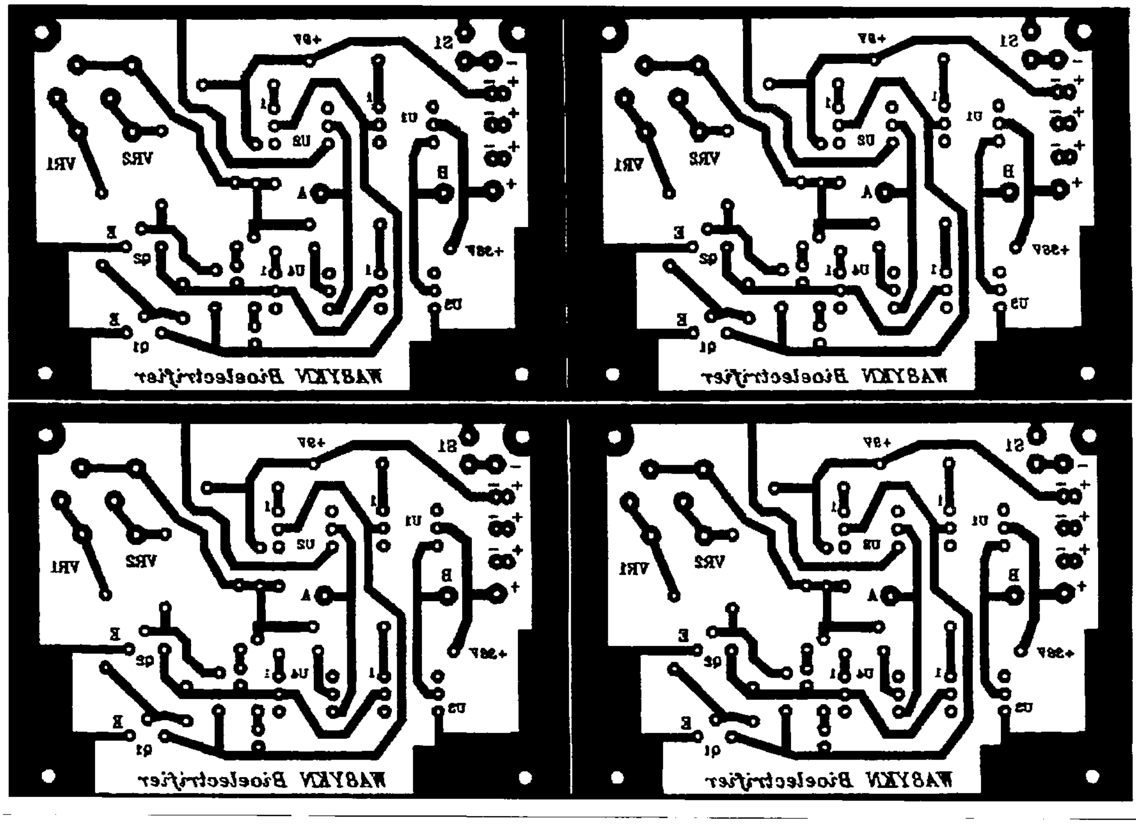


Fig. 4. Make your own "positive" by copying this mirrored pattern onto clear Mylar. Shown actual size.

NEVER SAY DIE

Continued from page 4

to help force your state university, with the professors kicking and screaming in protest, into the 21st century.

Self interest

It's about time you got involved in politics instead of griping about family values, the deficit, crime, drugs, welfare, and so on. If we can get our kids learning about electronics and other high-tech fields, we may even be able to help keep some kids from being suckered into dropping out of school and going into the crime or drug business. This will be good for everyone, including you and your family.

For my part, I can easily turn out the needed magazine. I've put out big magazines before, and I suspect this one, with a circulation of 20 million or so, would probably run several hundred pages a month, with eight editions, one for each of the eight grades. No problem, though I'd probably have to get a couple more Macintoshes for production. And I'd draw on you for the articles, encyclopedia of electronics series, and so on. The material has to be fun to read, as well as simple to understand. Right up the alley of several good ham writers.

Will we be seeing a million-ham day at Dayton? Why not? We might have to move

Continued on page 31

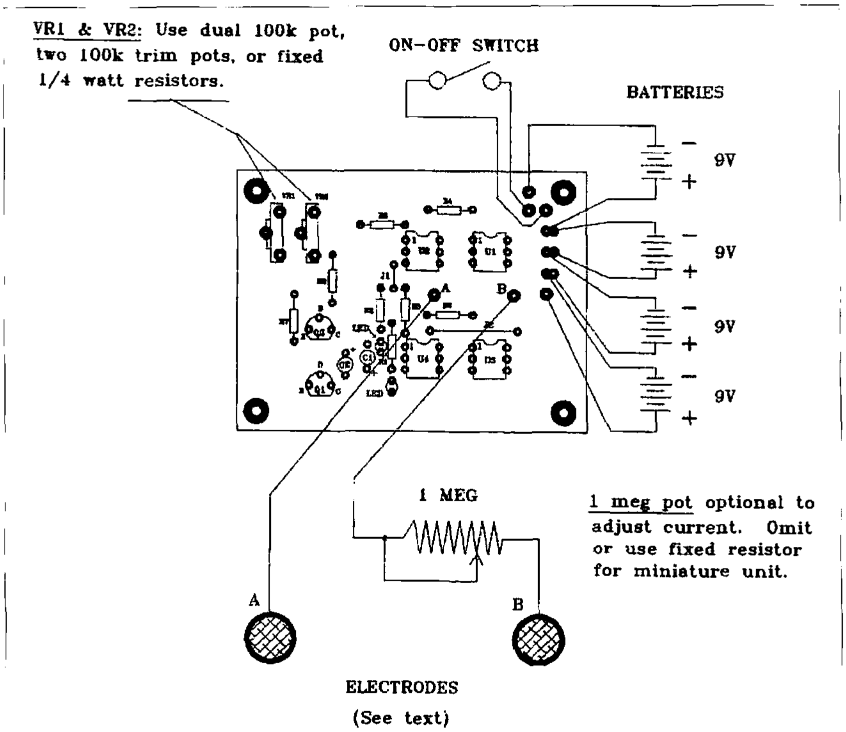


Fig. 5. Component side of the board, showing the component locations and connections.

amateurs—since the professionals do not yet exist!

One final caveat... *do not* build Bioelectrifiers and sell them as medical devices! This will surely bring unwanted attention from the wrong people. After all, these days even the U.S. Department of Health and Human Services has a S.W.A.T. team! So build it, work with a doctor to experiment, and make sure to keep careful records. Don't even give one away to someone who wants to try it but doesn't have the skills to build it, unless you have no qualms about opening yourself to almost unlimited liability. Remember, the FDA and several other government agencies have unlimited funds to persecute you, and they love nothing better than the slightest excuse to appear to be working. The last thing you need is to get the attention of the bureaucrats, who would probably protect the interests of the pharmaceutical cartels by outlawing bioelectricity, requiring us all to wear grounding straps on our behinds.

I would be interested in hearing about your results with the Bioelectrifier. Those with Internet access can send me E-mail at THOMIL@delphi.com.

A Note From El Supremo: *I highly recommend the inclusion of the 1 meg pot in series with the electrodes so that the current can be kept comfortable for the user. I adjust it so I can feel a throb, but no pain. Also, as I mentioned in my editorial, I find it easier to put the electrodes on one wrist, where there are two arteries, and keep them in place with an elastic strap. There is still a need to blast hiding critters out of the lymph glands with a coil in series with a flash gun. Then the Bioelectrifier will take care of 'em!*

I like Bob Beck's latest approach, labeling the device as a "plant growth stimulator." A commercial model, which I've been using to stimulate the degrowth of any possible viruses, bacteria, fungi, or parasites in my own aging body, is clearly marked as an experimental plant growth stimulator, not to be used on humans. I also liked Bob's sheaf of before and after lab reports of people who had had the HIV virus, which I looked over at the Global Sciences Congress in Tampa a few weeks ago (which you didn't bother to attend).

I would make a lot more noise about this except for two things. Make that three. First, I'm not an MD, so the medical industry will probably have no interest in anything I have to offer. Second, efforts to try and bring down the costs of medical treatments could easily trigger an FDA attack and prison. Ask anyone who's read about what happened to Wilhelm Reich, Raymond Rife, Gaston Naessens, and hundreds of others. Third, I'd sure like to have some people come out and say that they were dying of AIDS and a blood purifier saved their lives. Or even a few of the people to whom I've sent circuits to call or write and say they used it with success. I've never had anyone write and say they had tried it and it didn't work. I've had phone calls saying it did, but no written proof.

So, is this one of the biggest medical discoveries of the century and Bob Beck in line for a Nobel Prize? ignoring it, as the NIH and WHO have, isn't the answer. Trying to stamp it out, the FDA's approach, isn't either.

Can it really wipe out parasites and viruses in your or your pet's blood, or is it only good for stimulating your hemp growth?

Parts List

Qty	Part	Mouser #	Radio Shack #
2	Transistors	333-PN2222	276-2009
4	Optocouplers	512-4N38	- -
2	LED	351-3001	276-026
1	Dual Pot	31VA501	271-1732
2	4.7 µF capacitors	140XRL16V4.7	272-1024
8	1K Resistors	299-1K	271-1321
1	9V Snaps	12BC310	270-405
2	"N" Holder	12BH510	270-405

Box, switch, batteries, etc.

Materials for Circuit Boards

Materials to make your own printed circuit boards are available from Circuit Specialists, (800) 528-1417.

Part	Number
Sensitized Boards	PP114
Developer	Posdev
Etchant	ER-3

Belcher Islands DXpedition

Take off to the Great White North.

Winston Seeney VE3WFS
224 Cornwallis Court
Oshawa, Ontario L1H 8E8 Canada

If my wife could have seen me at that moment, she would have written me off as a madman. What teacher in his right mind would begin his summer vacation standing with a friend atop the airport garage at Sanikiluaq? The arctic wind whipped our pant legs like flags. The coax and guy ropes danced to their own senseless rhythm. From moment to moment, the precipitation switched back and forth from rain to snow to rain... seemingly unable to decide which torment we most deserved. John Harden VE3VGI shouted through chattering teeth, "What a contrast! When we put this thing up four days ago, it was 82 degrees and we were wearing shorts."

Al Griffin, our pilot, watched from the warmth of the nearby pre-fab airport. His face mirrored his concern; which one of us would be blown over the edge? Was our struggle worth it all? Al hadn't read John's sense of determination well. John is an athlete, and for years he has boxed, run marathons, and driven his body to the limits of endurance in cross-country ski races. For John, this marked the end of months of hard work. Our Belcher Islands DXpedition was in the books, another of a lengthy list of accomplishments in the story of a unique man.

"Thanks, guys. I'm a handicapped operator—you make it easy for me to travel the world."

It seemed like yesterday when John, Laird Solomon VE3LKS, and I sat in a Tim Horton's in Oshawa, on the eastern edge of Toronto, discussing a possible DXpedition. As I stirred my coffee, I quietly commented, "This is every ham's dream, but how many do it? If we say we will do it, we will."

The gauntlet was thrown. From that moment on, we agreed to a goal that had to be met. Unfortunately, the end came for Laird four months early when his wife, Connie, entered her final term of pregnancy. Laird had to withdraw from the team, but at that time, when doughnuts, coffee, and idle conversation came easily, we dared to dream.

Where would we go? Our trip had to be remote, yet affordable and attractive enough for both local and distant hams. If we were lucky, we would provide a first-time activation. At first, we thought of the High Arctic. Names like Ellesmere Island and Alert Bay rolled off our tongues, but when a local pilot suggested a fee of $10,000 to transport us and our gear to Calumet, a large community on Baffin Island, we decided to change our destination to a more affordable, southern location.

After much consideration, we decided upon Sanikiluaq, in the Belcher Islands of Hudson Bay. John discussed the problem with a friend who worked with him at General Motors. John's friend was a pilot and, although he liked the sound of the trip, he was unable to make it because his health failed. He passed us along to his brother, who was also a pilot, and who also liked the idea. We had the green light.

For our pilot, Allan Griffin, an air controller at Toronto's Lester B. Pearson International Airport, our trip to the Belchers fulfilled his long-held dream of flying to the north. His plane was a hardworking

Photo A. *Winston Seeney VE3WFS and John Harden VE3VGI*

little PL 30 Twin Comanche. It had been flown for years by Henry Shannon, traffic's voice in the sky for radio station CFRB, Toronto. Allan provided us with an affordable DX opportunity by sponsoring us with a return flight from Oshawa to Sanikiluaq for the cost of fuel.

Having overcome the transportation hurdle, we were faced with the problem of siting a station in an unfamiliar town. To save expenses, we decided to establish a base with tents and portable camping gear. We also decided to huddle as close to the airport as possible. With that in mind, we contacted Bob McLean, an airport employee at Sanikiluaq. We needed whatever support he could offer from the airport: electricity, toilet facilities, a refrigerator, and protection from bad weather. When we arrived at Sanikiluaq and learned that the airport wasn't very busy, we asked Bob if we could work from inside the building. Bob's response was a laid-back, "No problem, help yourselves, guys."

After arrival, John and I took a quick overview of the terrain around the airport. The airport and adjacent garage sat on a hill about 1,500 feet high and two miles outside of town. John, who had constructed and tested our rotating quad antenna, knew exactly how much space it required. The flat garage roof, some 30 feet off the ground, was ideal.

The skyline was magnificent. To the north, we could see the ice floes which had broken away from arctic glaciers and floated up to the island's shore. Below us, Sanikiluaq huddled around a small inland harbor. Surrounding us were hills and tundra. We set to work, snapping the telescopic sections of mast pipe in place. Then came the supporting guy wires, followed by the large triangle-shaped driver and reflector wires. After we had completed the familiar ritual of untangling wires, the structure was drawn tight.

Our next problem was feeding the coax into the room which served as our shack in the airport. We couldn't keep the outside door propped open because the temperatures dropped too low at night, and during the days the mosquitoes drifted off the tundra in raiding parties. John spotted three holes in the wall that were stuffed with packing and appeared to have been used at one time as an entrance for cable. As luck would have it, they were in a wall of the room that we had selected for our shack and, with Bob's OK, we reamed the caulking out and shoved in the coax. Within hours the radios were fired up. We made a few test contacts and our initial reports were solid. After dinner, VE8RAC was up and running.

Our station consisted of three rigs: John's Kenwood 440, my Kenwood TS 50, and our sponsor, Durham Radio Sales and Service's Alinco DX 70. It had been our plan to rotate around the rigs, with one man having time free for himself. Allan, our pilot, respectfully declined to man a station. "Sorry, guys, this is a break for me from work. I talk on a microphone for a living." John and I found ourselves caught in a situation we hadn't counted on. Allan had been good enough to fly us north for the cost of fuel. We felt that we couldn't leave him to wander alone for three days while we DXed, so we decided that we would keep one radio operating full-time and we would spell each other off. This would provide Allan with a companion. We would double-team our station whenever we had the chance. For much of the time, this was a sensible decision. It meant that we could adequately rest, and combine our trip with the opportunity to explore the area and to fish.

On the air

VE8RAC went on the air on the evening of June 29th. We moved onto the 20m IOTA frequency and were immediately swamped with calls. We were pumped up. To work the receiving end of a pile-up brought into play all the art and skill of a thousand hams I had heard over the five years that I been a ham. I came into the situation determined to give everyone a fair chance, although there were times that this wasn't possible. The Voice of Texas demanded to be heard by covering weaker signals. "Answer him. Get him out of the way," was our feeling. Unfortunately, he was usually replaced by another 10-gallon operation. I suspected, though, that for every one mega-station, there were a dozen average barefoot hams in the background who were waiting patiently for their opportunity. We were thankful for the many hams who expressed their appreciation for our efforts. "Thanks, guys. I'm a handicapped operator. You make it easy for me to travel the world."

Occasionally, I would stop and invite QRP stations to take a shot. When we were operating above 14,500, I would sometimes give Canadian stations a chance to take a break for it. The frustration of untangling dozens of interwoven callsigns was heightened by the carriers of stations tuning up on frequency.

It soon became apparent that our choice of islands was a good one. For three days we were a hot commodity. At times, we moved down onto the 40 and 20 meter subbands to shake off the large demand by American hams, and to make international and national contacts possible. The constraints of time defined our operating practices. One evening I called into the Sandbox Net on 7063 kcs and spoke to Stephen VE3DP in Thunder Bay. Stephen had a nice signal into the north. A few stations in southern Ontario and the Maritimes were workable. Most of the stations on the net were quite low. Although I am a Sandbox Net regular, I found myself in a dilemma — trying to decide whether I should devote two hours to having hams try to wring out a contact with me at the expense of the very real possibility of working a couple hundred hams elsewhere. DXpeditions exist for multiple contacts, so I had to move on. The log

Photo B. Main Street, Sanikiluaq

became a monster which had to be fed, and it had a huge appetite.

Exploring the island

During our off times, we explored Sanikiluaq. It's an Inuit town of some 400 people, a cluster of small bungalows sitting nakedly on blocks above the rock-strewn ground. Most of them had multicolored beasts of indeterminate but wild lineage chained outside. Those dogs eyed us from their perches on top of snowmobiles, umiaks, and packing crates. As we walked along the streets, miniature all-terrain vehicles bombed past in clouds of dust. Smiling Inuit men and women waved.

John tuned the boom box, which sat on a desktop in our makeshift shack, to the Inuit-language local radio station. "Listen to this," he said. I expected chanting, drums, and the cry of a people thousands of years old, weaving in and out of the night like northern lights. Instead of mystery and poetry, the shriek of an alternative rock band violated the northern night.

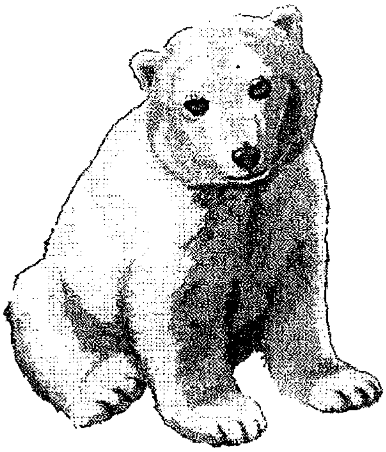
During my off times, Allan and I fished in the harbor. My catch was humble—a cod twice the size of my hand. The locals claimed that a Spanish fleet had beaten us to the punch. Allan drew in three grotesque fish with fins like fans, and bodies covered with knobs, spines, and bumps. I told Allan that he fished ugly and he laughed. The natives call that species Offish (ugly fish).

When we weren't fishing for DX contacts or casting into the harbor, we fished for soapstone carvings. We made our best contacts at the Northern Store. I suspect that the prices we paid, while modest by southern standards, were attractive enough to encourage the local artisans to sell to us instead of the local co-op. Bartering is part of the game.

All of the villagers speak Inuit, most speak some English, and English is the first language for the kids in school, so they made great interpreters. On our second day, a procession of all-terrain vehicles worked their way up to the airport from the village. Summer holiday had begun and with it came the annual exodus of the teachers to their homes in the south. We found ourselves explaining our presence over and over again to curious villagers and to the members of the southern white community who lived in the village hotel. These, for the most part, were

VE8RAC

Belcher Islands
Hudson Bay
NWT- Canada



Operators:
VE3VGI John Harden
VE3WFS Winston Seeney
Assisted by: Allan Griffin

IOTA-NA-196

Durham Radio Sales & Service Inc.

tradesmen and workers who worked in isolation during the summer months. These "Northern Junkies" came from across Canada to work in the north for isolation pay, for months at a time, before returning to their families in the south for winter. During the evening, they lounged about the colorful Amatuk Hotel, watching videos and making small talk. For some, our station was a diversion, and they enjoyed the chance to talk to someone new.

On July 1st, Canada Day, during my break from the radio, I was drawn to the bank of a small stream which ran through the village. A large group of Inuit had gathered around someone shouting through a megaphone in their language. I worked my way through the crowd and watched a game in contest. A dozen or so people were eagerly scooping water from the stream and into large containers, using small water scoops. It appeared that they were seeing who could fill their containers the fastest. The crowd then spread out and fanned past me. They were bent and focused on the ground. I stopped a high school boy and asked him what everyone was looking for. He told me that hidden among the rocks was a soapstone carving of a ptarmigan, a northern bird.

Meanwhile, on the hill outside of town, the airwaves were alive. John was passionately working the Canada Day contest. Throughout the afternoon and into the night, we worked stations back and forth across Canada from Vancouver Island to Newfoundland, but the Yukon was silent. Does it still exist? Is there really a VY1 land?

Because we had a coveted RAC multiplier callsign, we didn't have to go searching for contacts. Avid contesters dug us out of the multitude of "CQ Canada Day, CQ Canada Day," calls with a frenzy. John and I expected to work 20 meters throughout the night. We reasoned that because it was daylight in the north for 20 hours a day, our station would be operable. We were surprised to discover that, although it was still light, propagation dropped off late in the day, much as it did in the south. On the second night, the band was quiet from 1:30 a.m. to about 5:30 a.m.

Since the antenna faced Europe, we operated off the side of the quad to the west and into the Pacific. We found ourselves following the rim of darkness, as it worked west across Europe to North America and across the Pacific. Because we never changed the direction the antenna faced, we were unable to make comparisons with the success we might have experienced had we moved it around.

On the second night, I worked Australia and New Zealand at 0600 UTC. An enthusiastic ham from the vicinity of Melbourne helped me coordinate several contacts Down Under. On many occasions, signals had what seemed to be arctic flutter. On the other hand, it might have been the natural echo effect created from receiving a delayed "around the globe" signal off the back of the quad. We also used a vertical antenna for the 10 through 40 meter bands. Since it lacked the gain, we used our quad antenna in its place.

The three days were punctuated with frequent surprises. There were conversations with hams we knew from previous conversations. On one occasion, we broke a pile-up into the Franz Josef Land DXpedition, high in the Arctic Circle, to the north of Russia.

Throughout the time we were in the north, John had arranged for personal contacts and messages to be relayed by Glenn VE3AEQ, a fellow member of the North Shore Radio Club — our home club. He passed personal traffic for us. Messages were given to our wives: Yes, we were eating well and we were cleaning our teeth before we went to bed; the usual stuff. In the wee hours when it grew quiet, I found myself yawning and fighting exhaustion, so I slept briefly.

At 5:30 a.m. I was back in action. We came to life in a hurry on Sunday afternoon, when John called me to the radio to listen. Someone in Europe had thrown our presence on the 20m IOTA frequency on the Internet. The radio erupted into a blast of unforgettable sound. Thousands of callsigns melded together into an uncontrollable wave of noise. It sounded like New Year's Eve in St. Peter's Square, Rome. Eager Europeans joined the carnival atmosphere by blowing whistles and clapping their hands enthusiastically. John's professional skill was amazing. He called upon three hams with superior stations to sort callsigns out of the alphabet soup. GM3ITN of Glasgow and Dewitt Jones W4BAA of Michigan fed John lists of stations he could work, but a feeding frenzy has a mind of its own. John was repeatedly overridden by impatient hams who demanded that their appetites be fed. Again and again, John announced, "Gentlemen, please await your turn." I marveled at John's patience. When he reached the moment of no return, he handed me the mike. "Take over; that's enough."

With that I told the mob that there was no bread in the bag. It was time to go home. I changed frequency and slid down into the 20 meter subband. The hams with operating smarts won the day. They searched us out and earned their IOTA 196 QSL cards by outthinking the mob. During this time, I worked a station from near Paris, France. His 3 1/2 watts earned a respectful 5 x 8 report. Nice contact!

While the Belchers were much in demand, we learned that we were the second DXpedition to the Belchers. During the three days, we worked Tony WT2O and Martin G3ZAY, both of whom had been part of a DXpedition here the previous year. They had operated from a tent station outside the hotel during their stay.

Eventually, the time came to pack up the station. With our soapstone carvings tucked away in our baggage, we boarded the Twin Comanche. As we rolled south through the valleys of clouds, each of us privately reflected. Would we do it again? You bet!

routinely design transmitters and receivers with parts costs below $30. From my experience, I can only conclude that ham radio equipment companies are enjoying high profit margins on their products. These profit margins are adversely affecting the growth of our hobby by establishing financial barriers that inhibit young people who wish to purchase their own equipment.

Thirdly, I must applaud your editorial comments on maintaining a healthy lifestyle. I became involved with body building about a year ago, for stress reduction purposes, and can now attest that a lifestyle based upon good eating habits and plenty of exercise, both aerobic and strength training, is essential for success in whatever you do. As a Canadian citizen who has recently moved to the U.S., I can provide many stories concerning the demise of the Canadian health care system which has resulted from abuse and irresponsible behavior. Those who advocate socialized medicine, be wary! When the state takes on the medical expenses of the population, the population must take on the responsibility for living a healthy lifestyle. If both parties do not actively fulfill their obligations under such a contract, failure will surely occur. Thanks for a great magazine.

Fiddlesticks. I've been hearing this high priced ham gear complaint ever since I got into ham radio. It's a bunch of baloney. You want to know about high prices? Check out commercial equipment. Sure, manufacturers have to get back some of their R&D costs as part of the price, but I know of no other high tech field where margins are as cutthroat as they are in amateur radio. If there was any money in manufacturing, we'd have more manufacturers. And without the huge Japanese ham market supporting us, we wouldn't have that great stuff form Icom, Yaesu, and Kenwood! An S-19 Sky Buddy receiver of 1938 cost $20. That's about $400 in today's dollarettes for a five-tube wide-as-a-barn drifting receiver. My SX-24 cast about $90 in 1938, which is around $1,800 today. It was a nice receiver, but not that nice. It drifted a lot too. ICs are consistently bringing ham gear prices down for us...Wayne

Mike Agsten WA8TXT. Many thanks to *73 Amateur Radio Today* for publishing "The SP-10 'Senior Spider' Transceiver" in the Jan. 1996 issue. Regrettably, the all-important Parts Overlay drawing, *Fig 3*, page 17, did not condense very well into the space available. Any reader desiring a larger, more legible copy need only send me an SASE requesting SP-10 POL. 73! Mike Agsten WA8TXT, 401 W. Bogart Rd., Sandusky OH 44870.

Glenn Farr N4AK. I just want to let you know how much I agree with your editorials about getting our youth involved in electronics and science via amateur radio. I hope to soon have time to get involved actively as an "Elmer." You're right on target in advocating removing the code requirement from the license exam. I am still fairly proficient in the code and enjoy many contacts during the year on CW. The code should become just one of the many facets of this great hobby like packet, DXing, rag-chewing on SSB, etc. In other words: If you like to operate CW that's just fine, but let's not kill the future of our hobby over something that has served its purpose. Obviously some of CW's main supporters haven't yet experienced the Internet to see what our hobby is competing with!

Here in Greenville, SC, as in many other areas of the country, restrictive covenants concerning antennas (and in particular amateur radio antennas) are to be found in all subdivisions. In order to accommodate my hobby and hopefully have some fellow hams as neighbors, I decided to develop my own subdivision (Nature's Watch subdivision) with a provision for amateur radio antennas. Month after month of reading "if you don't like it, get off your duff and do something about it" in your editorials influenced me to strike out in a new direction after spending 25 years with Philips Medical Systems selling and installing X-ray, CT and Magnetic Resonance Imaging systems. The first project therefore is Nature's Watch, a subdivision that will have only 23 home sites on 65 acres—adequate space to accommodate "a few good hams." Now how's that for a retirement project? Keep challenging us!

Wow, imagine the 24-hour a day TVI with 23 ham families on 65 acres! ...Wayne

William Thim Jr. N1QVQ. Mr. Green: I have sent in some items for the new "Ham to Ham" column, one of which dealt with special event stations using packet BBS addresses for contacts. I am a no-code ham at this time, limited to 6 meter SSB, 2m FM, and packet. The letter I received from Dave got my gray cells going. So far I have contacted and QSLed some two special event stations via packet because these are the only two I have found that give packet addresses from the sysops. I would like to know how many contacts were in "real time" vs. packet BBS. There is a ham in my area who runs a VHF/HF gateway. If more hams did this throughout the country special event stations could give packet addresses and the callsign of the local gateway for contacts. Not only would this help more people contact/celebrate the special event, but it would be *great* disaster training; i.e., how long would it take to get messages from a family in Minnesota to hurricane-ravaged Florida? Would it be possible to have different VHF/HF links between relatives in New England and disaster survivors of a quake in California? Good training exercises. Well, before I ramble on too much, let me tell you to keep up the good fight and congrats on your crew who keep our gray cells active.

Thanks, Wm., but at times it seems like we're fighting insurmountable odds...Wayne

Mark Jackson NØOWE, President SPARK (Sedalia/Pettis Amateur Radio Klub). There seem to be two schools of thought. The first, that there should be no code requirement because it is an outdated form of communications. The second, that no-code Techs should never have been permitted. Most no-coders, contrary to popular belief, fully understand why so many older hams feel the way they do. They had to struggle to learn code, many had to drive long distances to take their examinations, and if they failed, they had to start the process all over again. I can sympathize with this position, but this should not be used as an excuse to hold the hobby back. It is the same whether you are a ham or work for a large business. Many old-timers, in either case, will fight tooth and nail to hang on to the old ways and resist change as long as possible.

Instead of resisting change, why not take advantage of the opportunity to experiment with today's technology? One reason many Techs haven't upgraded is because they find so few benefits to using the code compared to the more modern communications modes available. Most of them have computers, so it's easy for them to set up their stations to send and receive Morse code at practically any speed. The computer does all the work. Most old-timers stay on HF and tell each other what type of rig they bought, what antenna they bought, what the weather is, and how loud their signal is. Sounds like a code test session!

Our local club had become one of Wayne's so-called stagnant clubs. Through reorganization and a lot of hard work we are making a comeback. During the last quarter of 1995 we held a Tech licensing class to help try and boost the hobby. We successfully licensed all but one individual. We started a new class in the first quarter of 1996 and will teach Tech, Tech-plus, and General. Several of our Techs will be taking the General or Tech-plus test. Most of the Techs I know value the wisdom and experience of our old-timers. I have learned a tremendous amount about the hobby from the older hams in our club. Maybe it's time for both sides to break down the barriers and take our hobby into the next century on the cutting edge.

So send a picture of your next graduating group...Wayne

Chuck Marlin AB4Y. Wayne, I just wanted to let you know that I've accepted an offer from a major telecommunications firm, and that my career success is due in no small part to you, and your decision to bring me on board at *73* magazine in the summer of 1982. The internship I served with *73* was one of the highlights of my life. Not only was it an excellent learning experience, but I enjoyed spending a beautiful

Continued on page 46

Editor's note: If you liked the 440 MHz J-Pole last month, here's how to build a version of it for 220 MHz.

Number 26 on your Feedback card

A 220 Super J-Pole Antenna

220—Use it or lose it. Here's a simple, inexpensive one-hour building project.

Marty Gammel KAØNAN
1703 Hewitt Ave. West
St. Paul MN 55104-1128

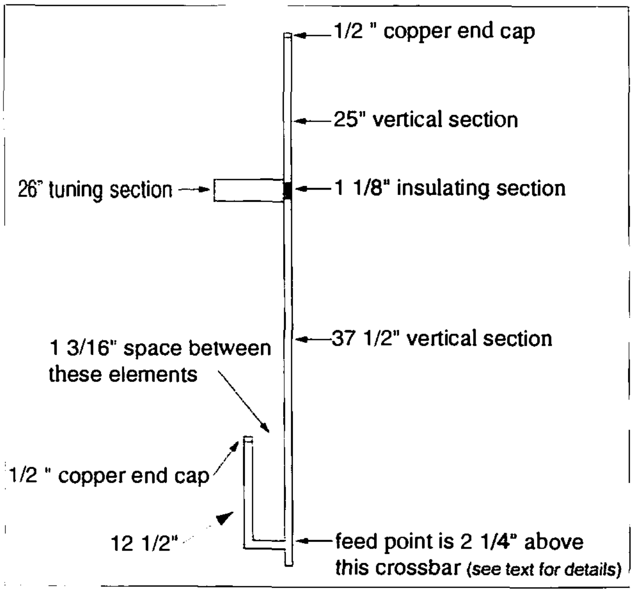
A local swap net helped me land an old Kenwood TH-31AT in good working condition. OK, now I needed an omnidirectional gain antenna. I found very few published 220 antenna projects in the ham magazines, and even fewer commercial gain antennas available. That was no problem, since I've made many J-poles over the last 14 years. The Super J-Pole has about the same gain as a well-known commercial brand antenna (about 5.5 dB), but without its poor low-angle radiation, which is more attuned to contacting aircraft than land stations. I knew my design would work with a broader bandwidth and lower SWR.

I made this antenna in less than an hour, once I had the materials on hand. Tuning it was easy; I spent less than 5 minutes finding the minimum SWR setting. My 220 Super J-pole has an SWR of less than 1.1:1 over the entire band, and with a little more fine tuning, I'm sure you can achieve an almost flat SWR.

Building it

Once you have all of the materials you can start this project. Cut all of the pieces to the lengths listed and clean the areas that will be soldered. I used solvent to clean all the copper surfaces (The secret to soldering copper tubing with a propane torch is to get the surfaces really clean). After the antenna is complete and soldered, the entire antenna should be polished clean with steel wool or a scrubbing pad.

Find the center of the 26-inch length of 3/16-inch tubing or wire, grasp both ends and loop the center around a broom handle or nearby pipe. Pull on both ends, and smooth out any kinks. It should now look like a very tall "U". The other bending of this section will be done just before tuning the antenna.



Now drill a hole about 3/16 of an inch from one end of the 37.5-inch piece of copper tubing, about halfway through the birch dowel, and 3/16 of an inch from the end of the 25-inch section of copper tubing, using the sheet metal heat shield as a spacer. Lay the parts out on your work table in the order they will fit together.

Dunk the pieces of 1/2-inch copper tubing right into the can of paste flux. Apply flux to the undrilled end of the 37.5-inch length of tubing, and slide an end of the "T" fitting onto it. Flux both ends of the base stub section and slide one end of the stub into the other end of the "T". Push the threaded 1/2-inch copper fitting onto the other end of the base stub.

Apply flux to both ends of the 1-1/8-inch crossbar piece. Insert one end into the side of the "T" and the other end into the 1/2-inch copper elbow. Finally, flux both ends of the 12.5-inch section of copper tubing, and put the other end cap on one end of the 12.5-inch section. Insert the other end of the 12.5-inch section into the open end of the copper elbow.

Measure the spacing between the 12.5-inch section and the 37.5-inch section. The 1-3/16-inch spacing must be equal at both the top and bottom of the 12.5-inch section. You may want to set a weight across these two sections to keep them in alignment when soldering.

Insert the 1/2-inch birch dowel into the top of the 37.5-inch section of copper tubing. Now is the time to bend the piece of thin sheet metal around the dowel to act as a heat shield during the soldering process.

Slide the 25-inch section of copper tubing onto the exposed end of the birch dowel, drill holes through the birch dowel, and install the 26-inch length of 3/16-inch tubing into the 37.5-inch and 25-inch vertical sections of the antenna. Finally, install a 1/2-inch copper end cap on top of the 25-inch section.

Soldering it

Check everything carefully before applying the propane torch. Then start at the bottom joint and work your way up, using the angle of the torch's flame to

heat the copper tubing without overheating. Discoloration will indicate overheating. The end caps are the last items to be soldered. Then wait for the rest of the joints to cool down.

After all soldering is completed, clean the antenna with solvent and paper towels. Remember, all flux must be removed from the surfaces. At this point you may want to coat the insulating section with a flexible caulking or silicone compound and then wrap the area well with electrical tape to weather-seal the dowel area.

Wiring it

Using a drill press, I used both the 5/64-inch and 3/32-inch drill bits to make the elongated mounting hole in the SO-239 fitting for the hose clamp. I like to use a small drill first and then the 3/32-inch bit, since that almost eliminates the need to file the opening. If you have a small file, you can use it to make a better-looking opening. Solder the length of copper wire to the center terminal of the SO-239. Mount the fitting to the 1/2-inch copper tubing with a stainless steel hose clamp. Attach the SO-239 feedpoint assembly with clamp to the 37.5-inch section of 1/2-inch copper tubing about 2-1/4 inches above the crossbar. Using the other clamp, mount the loose end of the wire to the 12.5-inch section of 1/2-inch copper tubing, also about 2-1/4-inch above the crossbar. After attaching the completed feedpoint, trim off the excess wire from the clamp area.

Tuning it

I clamped the base plate to my stepladder to use as a test stand. Using a support like this will make it easy to adjust the feedpoint for lowest SWR, and provide a handy shelf on which to set your tools, radio, and SWR bridge. First check the SWR at the top, middle and bottom of the band. If you started with the 2-1/4 inch above the crossbar measured at the bottom of the wire, the lowest SWR point should be very close. Move the feedpoint up or down no more than 1/16 of an inch at a time, checking the SWR reading after each adjustment, until you are satisfied.

After tuning the antenna, scratch a mark where each clamp mounts, and then remove the clamps to give the antenna a final cleaning. Remove *all* the flux and skin oils left from handling the copper with bare hands. Polish the complete antenna with a scrubber pad at this time. Reinstall the feedpoint clamps and recheck the SWR.

Spray the entire antenna with clear exterior lacquer, varnish, or sealer to keep it looking new for years. If you want to apply a little silicone sealer to the back of the SO-239 where the wire attaches, do so now.

Notes on it

It can be easier and more fun if you and a friend build your Super J-poles together, maybe even as a club project. Tune the antenna in an open area away from any wires or large solid objects that may give you false SWR readings. The 3/16-inch tubing should be bent into a half circle pattern, with about a 5-inch radius. You will want about 1-3/4 inch of space between the upper and lower halves of the 3/16-inch tubing. The distance of the end of this matching section from the vertical sections of the antenna will affect tuning to a minor degree, but it also helps balance the antenna.

Be sure to use an SWR meter that is accurate at 225 MHz. Most HF SWR bridges are not much good for VHF. Tape your coaxial connection well to seal out the weather, and tape your feedline to your mast; keeping it taped means less stress, and less possibility of future flapping.

Anyone with questions about my antenna designs may write to me direct, sending a #10 SASE. 73

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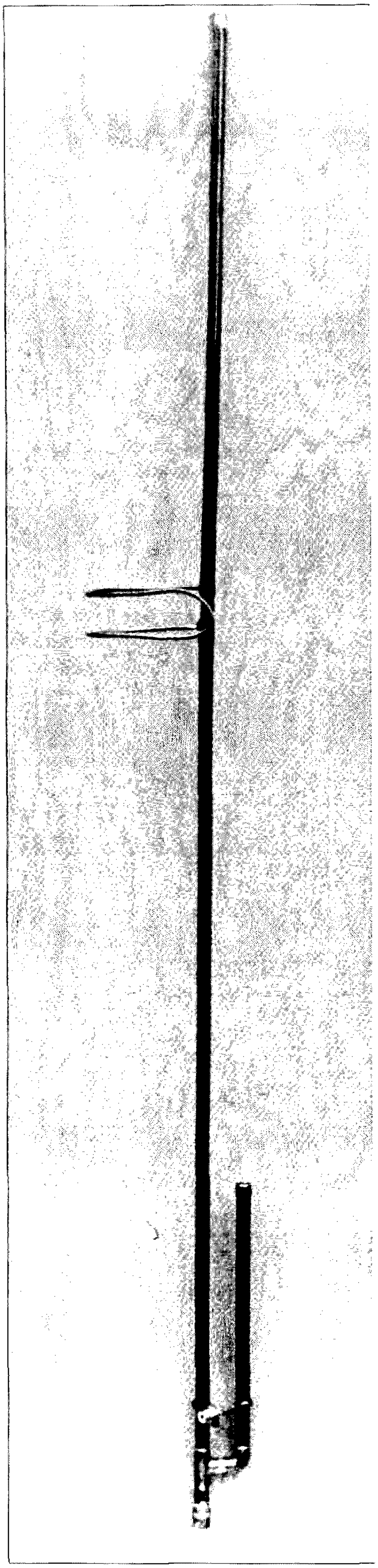

Photo A. *The finished 220 Super J-pole antenna.*

The Difference Is Dedication

Ham radio saves four communities.

Alfred A Mikalow III K7OOZ
55371 McDonald Road
Vernonia OR 97064

The snow had been building up in the mountains. In a week, at the 1200-foot high Vernonia Peak Observatory, 15 inches had fallen. The higher mountains had received two feet or more. Then the rain started. A layer of ice half an inch thick covered the snow. On February 4, 1996, weather patterns changed and the Jet Stream moved from the Arctic to the Tropics. The precipitation changed to warm, heavy rains, and the temperature went up to the mid 60s. The ground had been saturated since before the snowfall; it couldn't handle any more water.

The problem was exacerbated by the clear-cutting of timber in the Coast Range mountains. Without the roots of trees to hold the ground in place, the earth moved. Whole mountainsides collapsed, destroying bridges and roads.

On the 5th and 6th of February, the waters started to rise. By the 7th, most area rivers were well over their banks. *All* the major rivers in the Northwest were overflowing by February 8th. Portland was sandbagging the seawall on the Willamette River. The Columbia River, as well as any other stream in the area, was above flood stage by several feet.

The 1996 flood peaked on February 9th on the Nehalem River in Vernonia, flooding about two thirds of the town. In places the water was as much as 8 feet deep, leaving a layer of mud wherever the waters touched. On February 8th the only local hams still able to operate, Cherie KA7ILQ and Norm KB7CD, put their amateur radio skills to work.

Landslides had taken out the police and fire 911 lines. The roads were washed out or covered by slides. An amateur radio station was set up at the firehouse, and for nearly a week, the hams would be the only means of communication in or out of the area. Over half of the homes in Vernonia had been flooded.

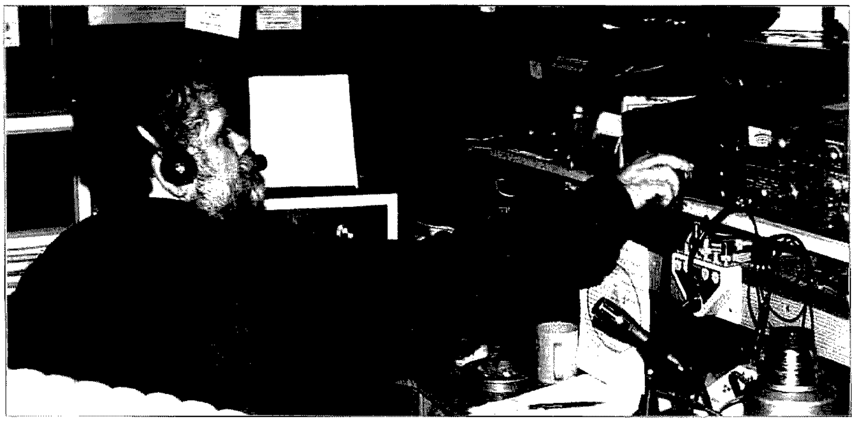

***Photo A.** One hero ham: Bill N7VZF ran the emergency net.*

On the evening of Thursday, February 8th, the Vernonia hams were sending through requests for food and other supplies. The hams who received those requests responded by going to stores in the Beaverton and Portland areas. By Friday, Wes K7WWG and many other hams had not only located the emergency supplies, but were mobilizing the resources to transport them to Vernonia, though the roads into the devastated area were nearly impassable, even for four-wheel-drive vehicles.

By now the Net on the South Saddle Mountain 147.32 MHz repeater in NW Oregon was in full swing. The EOCs for the affected counties were online, as was the Red Cross in Portland. Hams were providing radio links to almost all of the flooded areas in Oregon and Washington.

A call went out to get a helicopter into the Nehalem River valley, to check on flooding there. The call fell on deaf ears, and concerned hams were told by officials that there was no problem. One of the Vernonia hams, Sandy K7OOZ, decided to spearhead a trip out to those areas. Sunday afternoon K7OOZ arrived via logging roads to find that almost all of the homes in Mist had been flooded. Emergency supplies were requested from Vernonia and by that evening six pickup truck loads arrived, at about the same time as the National Guard. Sandy stayed in Mist and the rest of the group went into other communities. Randy

KE7AF set up a ham station in Mist and worked with the National Guard and the Mist fire station. Again, official bulletins declared that there was no problem in Jewell or Birkenfeld. Four days later, it was learned that Jewell had been hit as badly as Mist.

Once again, emergency supplies were gathered and the same basic list the hams had acquired for Vernonia was sent to the school in Jewell. The hams set up a station there as well.On the evening of Tuesday, the 13th, the hams turned the food distribution operation over to the services in place by then. On the following Saturday, a portable Cell Phone transceiver was set up at the Vernonia Peak Observatory to provide communications for the Vernonia area. At 7:00 PM, Sunday, February 18, 1996, the ham network was closed down after eleven days of operation. Out of the eleven days the first four were 24-hour operations.

The devastation caused by the February flooding is hard to imagine, as was the amount of help provided by the hams. Seldom has an amateur operation run as smoothly as this one, thanks to Bill N7VZF who ran the net, and the hams who involved themselves so deeply, often digging into their own pockets to purchase what wasn't donated, and paying for fuel to transport the emergency supplies.

Until Sunday, February 11th, the hams were strictly on their own; there were no other organizations helping with the disaster in this area. At least a hundred hams were involved with supplies and communications; at least a hundred heroes who helped put nearly three thousand lives back together. The list is too lengthy to print here—the honor roll of the hams and other people who helped in the Flood of '96, but they know who they are.

Thank you from the people of Vernonia, Mist, Birkenfeld, and Jewell on a job so well done. The ham radio operators made the difference.

NEVER SAY DIE

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our hamfests to Las Vegas and other cities where there are facilities to deal with 100,000 attendees.

Communication

If you'll get involved with running for your state legislature I'll organize a web

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Number 32 on your Feedback card

Tape-Wound Antennas

Neat, efficient, and easy to build.

Peter Laakmann WB6IOM
The Highlands
Seattle WA 98177

Using white PVC plumbing components and adhesive copper tape, you can build microwave/UHF helicals or HF/VHF verticals, dipoles and beams; efficient, good-looking antennas that lend themselves to endless fun and experiments.

Simply wind a desired pattern of adhesive copper tape onto the pipe. The tape, designed for direct soldering, can be cut to any width by suppliers from stock "logs" of up to 20 inches, making this a "printed circuit" approach to building antennas. Painting or varnishing the finished design will produce a lightweight, rugged structure, well suited to severe weather. Another option is to Fiberglas™ the finished and tuned assembly.

Because of the skin effect, tape is just as good a conductor as a solid sheet of copper. In practice, tape is a *better* conductor since the surface area can be much greater than wire. Tape is also lightweight and the instant adhesive makes winding with it a pleasure.

Common PVC pipe comes in sizes from 1/2-inch to 4-inch diameters. Sizes between 1-1/2 and 3 inches are ideal for a great variety of HF and UHF projects. You can also wind 13 and 23 cm helixes and straight sections, build capacitive "hats," and do other tricks of antenna construction.

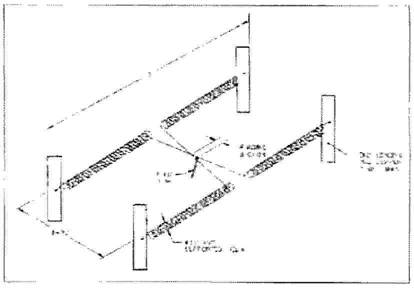

Fig. 1. *Suggested beginning design.*

For UHF applications, the formulas in antenna books for helicals can be followed directly. The PVC makes a convenient support for these circularly polarized broadband antennas. Three-inch PVC tubing in either Schedule 20 or 40 is rigid enough to construct 20 dB gain axial helical antennas for the 23 cm band; a rough rule of thumb is a circumference of one wavelength. Popular antenna books can provide complete details for pitch, match and ground plane dimensions. Performance should be essentially the same as any air-wound helical since the PVC dielectric loss is not likely to be significant.

As HF antennas, the tape-wound structure acts as a uniformly loaded transmission type structure that is electrically shortened relative to a free space dipole. The amount of shortening can be controlled by tape width and pitch. The advantage of the structure, aside from its simplicity, is the low loss or high electrical efficiency. A good starting point for resonance is that the physical length of the unwound tape is about one wavelength for a dipole.

This method of building small, efficient antennas compares favorably with small loop antennas. For a given maximum physical dimension both loops and dipoles have the same maximum possible bandwidth. However, a 10-foot-long dipole is lot less cumbersome than a 10-foot-diameter loop. This means in practice that a loop antenna is built to smaller dimensions and will then require remote tuning. Such remotely tuned tape-wound antennas (TWAs) have much to offer the home builder since everything needed can be found at the local hardware store, and a reasonably sized TWA can have adequate bandwidth without the complexity of remote tuning.

Performance

All small-wavelength antennas suffer conductor loss, but this is where the TWA shines. First, copper conductivity is better than aluminum, the common material used most in small antennas. Second, when compared with a wire-wound helical resonator, the tape width can be made as wide as the center-to-center turn spacing, reducing the resistance even further. The dielectric loss in the PVC is negligible as there is only a small electrical potential between adjacent turns. For these reasons one can expect the tape-wound antenna to have much greater electrical efficiency for a given length. Because of the large copper surface area, these antennas should be able to handle several times the legal

Continued on page 34

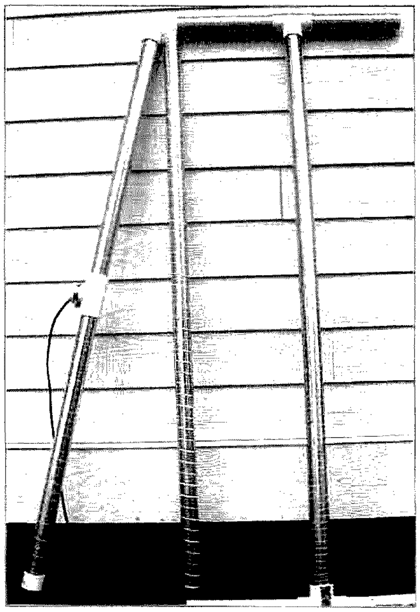

Photo A. *Tape-wound antennas come in many shapes and sizes. Although these are all about the same size, different winding techniques make them resonate at different frequencies.*

NEVER SAY DIE

Continued from page 31

page to help you communicate with the others so you can collectively learn from each other's successes and failures. You'll be way ahead of the other legislators, most of whom haven't any idea of what is going on in the other states.

I'm reserving some covers of *73* for the first few ham state legislators to get elected.

The first step

If you aren't in a position to run for your state legislature, how about getting your ham club members to work on finding a local ham to run? You must have a couple of members who have the time to get this ball rolling. Back them with all of the club members, their families, and as many of their co-workers as possible. With a core of 700,000 (if you bother to get the word out), and at least two more voting family members, plus three friends, we could have one heck of a lot of clout. Let's see, 700,000 divided by 50 states is an average of 12,500 hams per state. If each can generate six votes, that's 75,000 votes per state. And that's a major force.

But it means talking it up at your club meetings, writing articles for your club newsletter, and giving talks. You not only want to talk this up at club meetings, but get around to local business and social clubs. I've been giving talks to New Hampshire (and some Massachusetts) Chambers of Commerce, Rotary, Lions, Kiwanis, and so on. They all need speakers, and your message is exactly what they want to hear. And, being a ham, you're more used to talking than the average person. Hey, at the worst you'll get a lot of free lunches and dinners, plus a bunch of souvenir pens.

The people you'll be talking to are mostly small business owners so they'll be particularly receptive to your message. They know firsthand the results of our lousy educational system and are reminded of it every time they interview potential new employees.

If you're not good at speaking, you will be. All that takes is practice and a good solid knowledge of your subject. I was absolutely awful when I started talking at hamfests. It doesn't take long to get over stage fright. If there's some interest, I'll help with ideas on what to talk about. Or you can go back and swipe stuff from my past editorials. It's all there.

Once in

Step one is to get elected to your state legislature. Then you want to get on the educational committee. Next you want to talk with as many college presidents as you can. I think you'll find them highly cooperative. I know a bunch of college presidents and none have found any problem with my sneaky plan.

The next step is to start talking with local school boards, explaining the need for

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Tape-Wound Antennas

Continued from page 32

limit in power. The low loss allows you to build efficient short antennas. Simple calculations and tests bear this out:

The radiation resistance for short uniformly loaded monopoles is given by $h^2/312$ for electrical height (h) less than 45 degrees (1/8 wave). The radiation resistance of a dipole is double those values so that the radiation resistance of a short uniformly loaded dipole becomes $H^2/624$ where H is the dipole length in degrees. RF (skin) resistance of the 1.4 mil copper tape can be calculated from formulas or curves supplied in standard reference texts. However, these values are optimistic as they only apply to isolated straight conductors having a diameter much larger than the skin depth. The skin resistance is increased by the proximity effect. For a solenoid type winding using either aluminum or copper, the RF resistance is increased beyond the calculated skin resistance by as much as a factor of two.

I did some measurements of total loss on short sections with a "Q" meter, allowing me to calculate the total effective RF resistance on full-sized TWAs. Short 7- and 10-turn sections wound on 1-1/2 inch PVC tubing were used and measurements were made at 18 MHz. "Q" values of over 700 were obtained. The RF resistance inferred from Q measurements tends to be pessimistic for high values of Q because of losses due to radiation and resistance in other components of the meter circuit. The worst case estimate thus obtained showed RF resistance only about 50% greater than the calculated values that assume isolated straight conductors. These calculations assume current flow on the inside of the coil only. Therefore, calculating skin resistance from standard formulas by using tape width = wire circumference creates worst case errors of a factor of 1.5 (50%).

The radiation resistance of a 10-foot-long 3-inch-diameter helical resonator at 14 MHz calculates as 4.5 ohms. The loss resistance calculated for 1.5-inch-wide tape (56 feet) is 0.5 ohms; it is identical to the skin resistance of a 1/2-inch-diameter copper tube since both have the same surface area. This value must be divided by two because of the current distribution. Antenna efficiency is therefore about 95%. This represents about a 0.25 dB gain reduction over a full-length 33-foot dipole. The difference would be totally undetectable in on-the-air tests. For other shortening ratios, keep in mind that further shortening not only decreases the radiation resistance with the square of the length, but decreases the bandwidth even faster. The fractional bandwidth (without resistive losses) decreases with the third power of length!

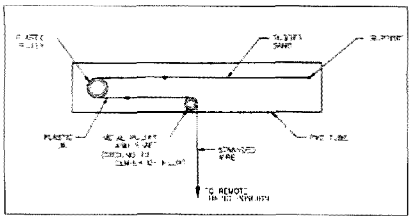

Fig. 2. Construction details.

Construction

Photo A shows a few of the structures tested using 1-1/2-inch pipe (1.9-inch o.d.). Three different tape widths were used to evaluate self-resonant frequencies. All structures are 5 feet long, using tape of 1/2-inch, 3/4-inch, and 1-inch width, closely spaced. The structure using end loading resonates at around 14.3 MHz using 1/2-inch tape. End loading stubs are 1 foot long and carry two strips of tape on opposite sides of the stub. The 3/4-inch tape structure resonates at 29 MHz. The 1-inch tape structure resonates around 45 MHz. 2:1 VSWR bandwidth of the 29 MHz TWA was measured as 250 kHz. A 14 MHz radiator of twice the dimensions would therefore yield a bandwidth of 125 kHz. Note the support tube attachment on the 29 MHz radiator. Using a saw, a "T" fitting is split, placed over the center coax connection, and clamped to the support tube with a hose clamp. The coax can then run down inside the support tube. Use good strain relief on the coax, because the tape is not strong enough to withstand pulling.

Scaling laws apply; doubling all dimensions will cut resonance frequency in half. That means doubling tape width, diameter and length of the PVC tube. Tape thickness does not affect resonance much, so it does not have to be doubled.

Close spacing, edge-to-edge, on the tape reduces ohmic losses. Losses are inversely proportional to tubing diameter for a constant tube length as tape width can be increased. However, when winding UHF helical resonators for use as axial beams, use wider tape spacing as more RF voltage exists between turns. Copper loss is not a problem in that case. I suggest using only 1/2-inch-wide tape for axial radiators.

Feeding and matching cable to HF TWAs is a snap. For a horizontal dipole, connect the coax shield to the center of the antenna (zero voltage point) and move the inner conductor to a point a few turns away until an exact match is found. No balun is required. For the test 29 MHz dipole (5 feet) with 3/4-inch tape the match was found at two turns. For the 14 MHz end-loaded dipole, the match was also found at two turns. If the frequency is off, simply unwind some turns and add a little tape or apply any form of end loading. The tape can be spliced and soldered easily.

For vertical dipoles the same principles can be used if the coax can be brought back at 90 degrees from the center. Monopoles working with a good ground plane are very simple. Just connect the end of the tape to the ground plane and the coax shield, then find the proper turn for the match as above. Make sure the ground plane resistance is less than the radiation resistance as calculated above. A half-wave monopole has a radiation resistance of only about 3 ohms! Of course, you can use two or three TWAs rather than full-length 1/4-

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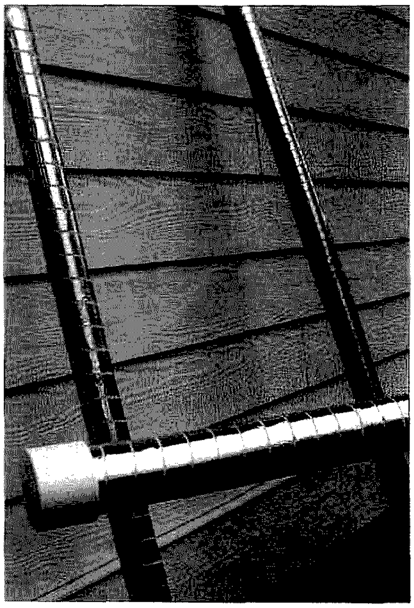

Photo B. Here's how to wind the tape onto the mast: close, but not touching.

Continued from page 33

change, and the low costs to their dictricts.

It's even possible to set up electronics labs for schools for next to nothing. Here in New Hampshire a friend of mine has been collecting no longer needed test equipment from electronics firms, refurbishing it, and giving it to local schools. He's found good school homes for hundreds of oscilloscopes and so forth. It's a nice nonprofit business that allows the donating companies to get a tax credit for their donations. Everybody wins.

I've got a lot more ideas along this line, but you don't need them now.

Who better to push for high-tech education than someone with electronics smarts like you?

Now, look around you. This is something that really needs to be done. If you don't do it, who will? It comes down to *you*.

Money

During the interview on the Art Bell W6OBB radio talk show I mentioned that if you're a ham you really should live on a 200-acre farm so you'll have plenty of room for antennas and no neighbors to bother. Well, obviously that takes money, Art pointed out. To which I replied that making money is easy, once you know the secret. Then we got off on another subject.

This resulted in several hundred people writing to ask about the secret to making money. So I sat down and wrote an instruction book, explaining the secret, and I put a $5 price tag on it. People might pay more attention if I charged $5,000, which it's well worth.

Several *73* readers have written recently asking about how to make money, so I suppose I should write about that now and then. I need an index to my editorials because I know I've written about this before. Probably many times.

Yes, it's possible to start from scratch and become a millionaire within seven years. Heck, it shouldn't take more than five years, if you're really serious about it. But that means throwing out almost everything you've been taught. Judging from the trouble I've had getting readers to change their diets so they won't be fat and sick, getting you to change your loser's approach to making money may be an even greater challenge.

The chances are that you haven't put any more thought into your future than I did when I was young. I took what came along. Everyone had to go to college to be successful, so I went to college. A war came along, so I went to war. After the war, like most everyone else, I went back to college. When I got out I started, for the first time, to think for myself. Instead of jumping into a big corporation like 99% of my school buddies, I said to hell with that and got a job as a chief engineer-announcer in a small North Carolina radio station. Small business. I handled the engineering, wrote and sold advertising, wrote programs, and had a great time announcing and doing DJ shows. I learned a lot and got very good at what I was doing.

But you're not interested in another Wayne Green bio. You are probably much more interested in how to make money. How to make a lot of money.

The basics

For starters, if you want to make money, doesn't it make sense to at least head your career in that direction? Or a second career, if you've screwed up the first.?And that means avoiding career choices which are never going to make much money. Like working for a large corporation, for instance. Another bummer is working for the government. A third route to nowhere is teaching. And what do our colleges aim you toward? Big business and teaching. Sucker.

They really love it when I lecture at universities on how to be successful. Well, actually, they don't invite me back as often as you might think because my message is that college is a total waste of time for anyone who wants to make money or accomplish anything significant. Even the professors get all upset when I discuss this because they realize for the first how badly they've been had by the system.

Remember John Taylor Gatto, the New York State Teacher of the Year, who pointed out that it only takes about 100 hours to teach a kid to read and write? Yet we have kids who manage to go through K-12 and four years or more of college without ever learning to read, much less write. If you think college grads can write you should read some of the mail and even articles I get. Pathetic!

My four years of college were pretty much a total waste for me, except as a bad example.

Yes, believe me (if you can), I know all of the arguments you're going to bring up. Sure, on the average college grads make more money than high school grads. But when you start looking into successful entrepreneurs, you're going to find the statistics show that few ever graduated from college. Many tried college and got fed up, thus putting them a few years ahead of the kids that hung in there for their diplomas.

There are very few jobs out there requiring a college diploma that are going to be very helpful to you in a career aimed at making money. Like just about none. So, if you are interested, no matter how old you are, in making money (isn't it about time?), you're not going to go back to college and piddle away another year or two. Or four.

Let's say you are in your 50s and could be downsized out of a job at any time. What then? Stacks of resumés? A few job interviews, followed by excuses. However, instead you can start from scratch and make it big time in five to seven years, depending on your dedication to success. If you're going to spend a lot of your time watching ball games and eating potato chips, you aren't serious. That's the route to oblivion, probably via a

Continued on page 47

Transmitter Hunting Equipment: A Club Project

Stimulate and strengthen your club membership.

Sam Guccione K3BY
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Camden DE 19934

Over the last several years a few members of the Kent County Amateur Radio Club (KCARC) in Dover, Delaware, have been active in T-Hunting. T-Hunting or transmitter hunting (also called fox hunting) is an amateur radio sport in which a transmitter, usually on 2 meters, is hidden, and hand-held radios with special electronic devices and directional antennas are typically used to find it. Joe Moell and Thomas Curlee have written an excellent book on this subject *(See "Sources" at the end of this article).*

Breck Smith K4CHE got me interested in T-hunts. The T-hunt bug bit so hard that I started harassing other club members to get involved. This reached such a level of intensity that I decided the only way to get enough hunters was to help people acquire or build the necessary equipment.

I started by using a simple device called an active attenuator. I constructed and used one described by PAØZR *(Sources)*. The design is very simple and a PC board is available from FAR Circuits. I was so pleased with it that I immediately built more. I gave away two and some parts for a third to encourage T-hunting. Well, this escalated into several club members' requesting lists of parts and where to get them, and from there it became a club project. Along with the active attenuator, some type of directional antenna is needed, plus a hand-held radio.

I designed a simple three-element beam to be used with the active attenuator, which several hunters have already copied. Let's build one!

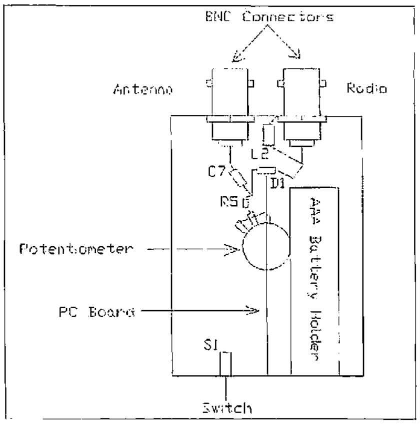


Fig. 1 Attenuator parts layout of inside of box. The PC Board is shown in a vertical position.

Constructing the active attenuator

Dave Holt N3RAE and I compiled the parts list shown for the PAØZR unit. If your club's members have well-stocked junk boxes, you may not need to order all of the parts on the list. Our club members paid half the cost of the kits and the club paid the other half. We built 27 attenuators, assembling eight of them in a couple hours during a regular club meeting. **Photo A** shows the top view of a completed attenuator. We used a regular potentiometer instead of the slide pot of the PAØZR article—it was a lot easier to drill a pot hole than to try to cut a slit for a slide pot. The switch on top marked "–25 dB" is a passive attenuator (described below).

Fig. 1 shows the inside parts layout, with the PC board vertical, supported at two points to simplify construction. Bend one of the potentiometer solder tabs vertical, and solder between the outside ground trace of the PC board and this solder tab. This provides one support point. Apply a dollop of hot glue between the PC board and the end of the potentiometer to form the second support.

"A bite from the T-hunt bug can start an epidemic of fun for your club, too!"

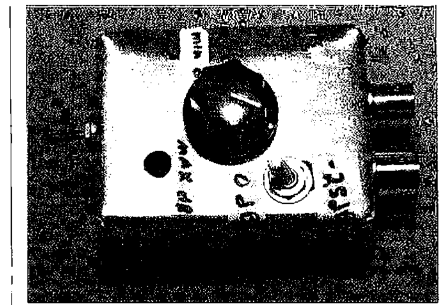


***Photo A**. Top view of a completed attenuator. (Disregard the hole below the words "MAX dB"...nobody's perfect.)*

Since an AAA battery was used instead of the hearing aid battery used by PAØZR, a small change in the connection to the PC board is required. Wire the red (positive) wire of the battery holder to the on/off switch. Connect a wire from the on/off switch (S1) to the hole just to the right of the silkscreened area on the PC board. Then solder the black (negative) wire anywhere convenient on the ground trace, which encircles the outside edge of the board.

Hot glue the battery holder to the box. The other parts shown in **Fig. 1** are self supporting after they're soldered in place. One ground lug was used under the ANTENNA BNC connector (J1) for the ground connection of L1 and to provide a chassis ground for the PC board. Be sure you connect the PC board ground trace to the metal box, or the attenuator will not work.

The circuitry is not critical and relatively long wires may be used instead of the compact construction shown. (See **Photo B** for the construction technique used by one club member in his attenuator.)

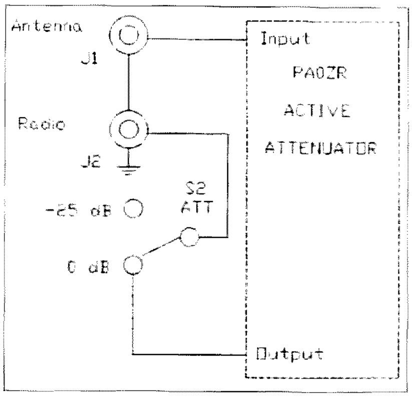


Fig. 2 Wiring diagram of attenuator with passive attenuator included. The passive attenuator is an SPDT switch.

Jerry Palmer N3KRX provided the idea to add a passive attenuator to be used in series with the active attenuator—it's just a SPDT switch wired as shown in **Fig. 2**. It provides 20 to 25 dB of additional loss, which (added to the active attenuator loss) gives 100 to 120 dB of attenuation for getting close to those high power hidden transmitters. If you feel that the passive attenuator will complicate your project, leave it out. Remember to wire the connector J2 directly to the active attenuator in this case.

Active attenuator operation and adjustment

The active attenuator works by mixing an incoming signal with a frequency generated by an oscillator inside the attenuator, to produce an output signal at another frequency. The oscillator frequency of this attenuator is 0.5 MHz. So if a 146.5 MHz signal is incoming, a signal of 147 MHz (146.5 + 0.5) is produced at the output of the attenuator. Since the attenuator is connected to your hand-held radio, this is the frequency that your radio should be set to. The potentiometer controls the signal level that goes to your hand-held. About 80 to 100 dB of attenuation is provided by this simple circuit. By the way, a frequency of 146 (146.5 - 0.5) could also be used since the active attenuator produces both sum and difference frequencies.

Adjusting the attenuator is simple: using the following procedure. Connect your HT, which should be set to 147 MHz, to the attenuator; put the HT rubber duckie on the attenuator input. Have a friend stand 30 to 60 feet away and transmit with his hand-held set as low as possible on 146.5 MHz. Adjust trimmer capacitor C1 for a maximum S-meter reading on your hand-held. (You may need to adjust the attenuator control R6 to keep the S-meter from pegging out.)

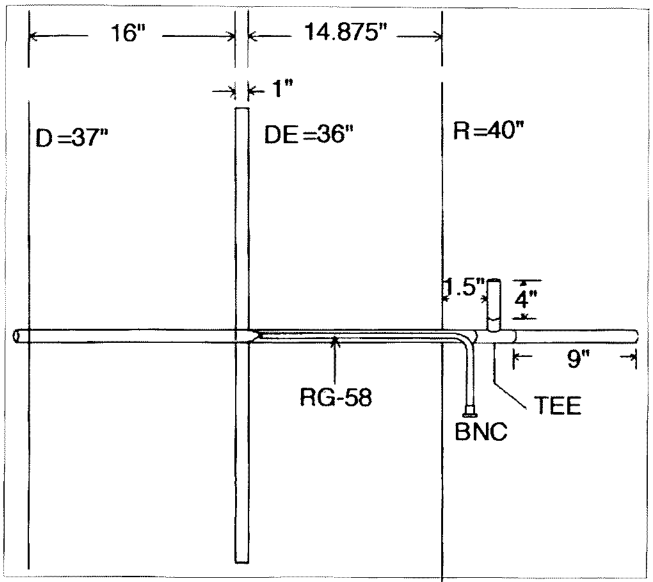


Fig. 3 Dimensions and construction of the 2 meter T-hunt beam. The driven element dimension of 36" is correct. The length was adjusted to achieve a low SWR.

Transmitting test

Although PAØZR didn't mention transmitting into the attenuator, I was curious. I tested mine with up to 5 watts for periods up to 3 minutes, without apparent damage. I would not recommend transmitting through the attenuator, but it is nice to know that if you accidentally key your hand-held with the attenuator attached, you won't burn it out.

Constructing the beam antenna

Many hunters have found that a yagi beam works best in most hunting situations. It is small, lightweight, easy to use in heavy brush, and simple to construct. I used the ELNEC program to design this beam. **Fig. 3** shows the dimensions and construction of the beam.

Brass brazing rods used for construction in this project were 36 inches long. Standard brazing rods are available in diameters of 1/16 inch, 3/32 inch and 1/8 inch. Be sure to use plain brass brazing rods and not the special coated ones or the center core kind.

As shown in **Fig. 3**, the boom is made from inexpensive, easy to use PVC pipe. The pipe tee forms a handle that uses your arm as a support for holding the antenna away from your body.

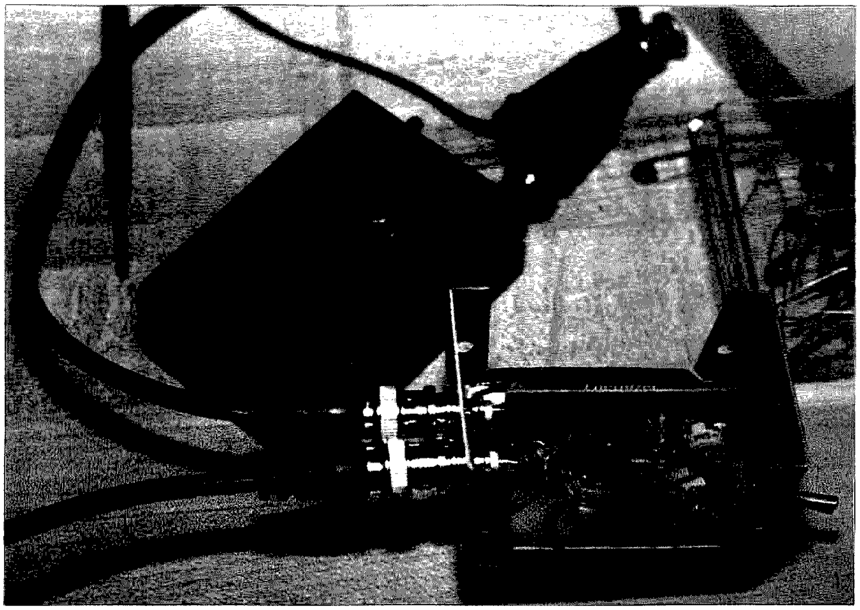


Photo B. *Attenuator construction technique used by one club member, showing long connecting wires.*

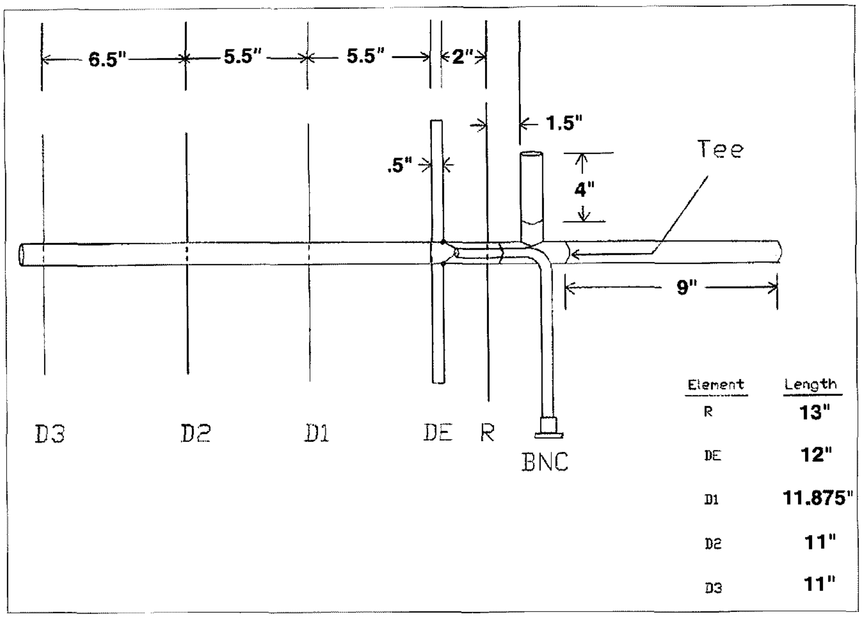


Fig. 4 Dimensions and construction of the 70 centimeter T-hunt beam.

The elements consist of the 36-inch brass rods with pieces of 3/32-inch (inside diameter) brass tubing used to extend the rod to the necessary length. You can probably find brass or copper tubing at your local hardware store or hobby shop.

Drilling the holes in the boom is a crucial step. I used a punch to mark the place in the PVC before drilling the 3/32-inch diameter hole for the elements. To maintain alignment of the holes during drilling, begin by drilling the hole for the director D at the distance shown in **Fig. 3**. Put a brass rod in this hole. Position the PVC so that the drill bit is over the next hole mark. Rotate the pipe until the brass rod is exactly vertical, and you can be assured that this hole will be vertical and in line with the first hole. You will probably want to clamp the PVC pipe. A drill press makes it easy to drill 40 or 50 holes if you are going to construct a large number of antennas, but we also constructed a few of the antennas with a hand drill. It took two of us to keep the drill straight so that the holes were aligned, using the brass rod for an alignment device as described above.

I made the director D by cutting two 2-inch pieces of the brass tubing. I slipped the pieces over each end of the rod, slid them so that the overall length was 37 inches with 18.5 inches on each side of center, and soldered the tubing in place. Be sure to mount the rods through the boom before soldering the tubing pieces.

To finish, you can put pipe caps over the three open ends of the PVC pipe, or not, as you prefer. They do not affect the electrical performance of the antenna.

I used a folded driven element (DE) in this design to raise the impedance, which should lower the SWR. The final SWR of my beam as measured with an MFJ-259 SWR meter was 1.1 to 1. Other antennas constructed by club members had SWRs of 1.1 to 1 up to 1.5 to 1.

The feedline is connected directly to the folded element. Antenna purists may object, citing lack of balance. However, I have built quite a few of these antennas and have not experienced significant pattern distortions; variations are not noticeable when using the antenna for T-hunting.

Hunting in the 70 cm band is catching on in various parts of the country, including Delaware. Since the active attenuator works well in this band, I have included the design and construction details of a 5 element 70 cm beam (**Fig. 4**).

If you purchase the materials for this beam at the same time you purchase materials for your 2 meter beam, you can reduce the cost of the 70 cm beam substantially.

The same construction techniques used in the 2 meter beam are used in this design. The SWR of my 70 cm beam was 1.8 to 1 as measured using an MFJ-219 UHF SWR analyzer. I have used this beam during a few 70 cm hunts held here in Delaware and found it to have a very sharp pattern.

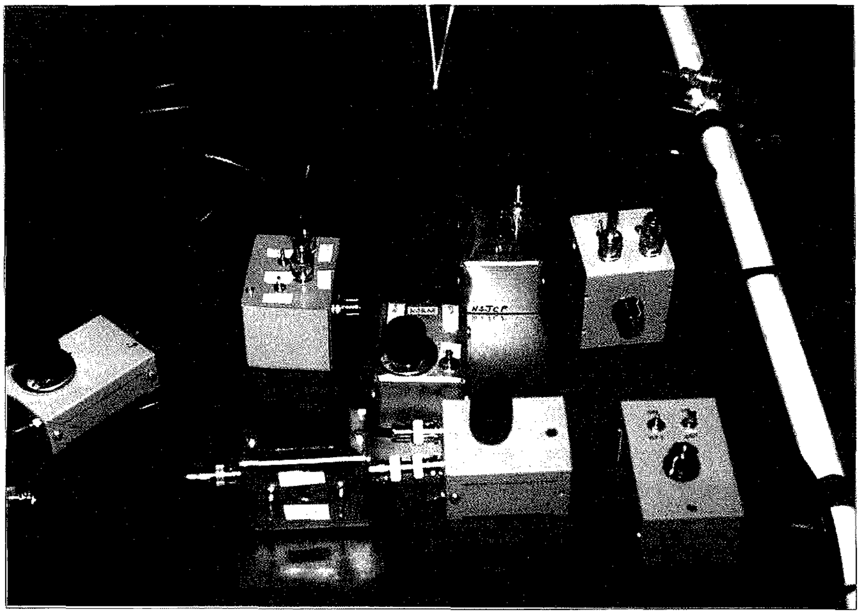


***Photo C.** Some of the newly constructed attenuators at end of the club meeting night.*

Testing the beam antenna

Connect your active attenuator to your hand-held, and the beam to the attenuator. Note that the coax jumper cable connects from the attenuator output to your hand-held antenna jack. Hold your beam with the elements vertical, as it would be used in most T-hunts. Make sure your hand-held is set to a frequency of 147 MHz.

Have a friend standing 30 to 60 feet away transmit with low power on a simplex frequency of 146.5 MHz. Point your beam at your friend and adjust your attenuator to produce a one-half to three-quarter scale reading on your S meter.

Swing your beam slowly to the left, then to the right. You should see your S-meter fall off on either side as you point away from your friend. Rotate your beam completely around in a circle. You should see your S-meter reach a peak value when the beam is pointed at your friend. You will also get an S-meter reading when you point your beam directly away from your friend, but this reading will be much lower than when the beam is pointed at him.

Change the antenna to the horizontal orientation and repeat the above tests. You should find the maximum S-meter reading occurring in the same direction as your friend's transmission. If neither of these tests works as described, have your club's technical expert check your antenna.

After our club members completed their attenuators and antennas, practice hunts were held, starting with a walking hunt. A small T-hunt transmitter was placed about a half mile from the hunters. I have written out the procedure we used and have included it below.

To the field!

First set the attenuator for minimum attenuation (maximum signal reception). Rotate the beam quickly around in a circle to get a rough direction, then fine-tune by moving your antenna in smaller arcs to find the maximum signal. Taking a bearing with a pocket compass can help at this point.

Begin walking in the direction of the bearing. Be ready to take a new bearing any time the hidden transmitter identifies. As you get closer to the hidden transmitter, you will need to increase attenuation by turning the knob. You can get a "feel" for how close you are to the transmitter by noting how much attenuation you have at each reading you take.

Well that's it. We ended up constructing a total of 27 attenuators and 15 beams as a part of our club project. Participation in local fox hunts has boosted our enthusiasm and our membership—we picked up a number of new members.

I wish to thank the members of the Kent County Amateur Radio Club (KCARC) in Dover, Delaware for their support in making this project a success. Special thanks go to Breck Smith K4CHE, my sounding board and technical advisor, and to the KCARC club president, Richard Lomax N3JCP, for taking the photos.

***Photo D**. Breck Smith K4CHE aligning an attenuator using his spectrum analyzer (on the left).*

I would be happy to answer questions or provide details not described to anyone deciding to take this project on. I may be reached by E-mail at sguccion@outland.dtcc.edu or by regular mail at 110 Chalet Court, Camden DE 19934.

Sources

1. Joe Moell and Thomas Curlee, "Transmitter Hunting: Radio Direction Finding Simplified," (TAB Books, 1987)

2. Eenhoorn, Anjo, PAØZR, "An Active Attenuator for Transmitter Hunting," *QST*, November 1992, pp 28-29,95.

70 Centimeter Beam Parts List

38"	1/2" dia. CPVC pipe
1	1/2" dia. CPVC pipe tee
3	1/2" dia. CPVC pipe caps
2	36" length 3/32" dia. brass brazing rods
3'	RG-58 coax cable with BNC connector
1 can	PVC cement

2 Meter Beam Parts List

50"	1/2" dia. CPVC pipe
1	1/2" dia. CPVC pipe tee
3	1/2" dia. CPVC pipe caps
4	36" length 3/32" brass brazing rod
18"	3/32" inside dia. brass tubing
3'	RG-58 coax cable with BNC connector
1 can	PVC cement

Attenuator Parts List continued on page 41

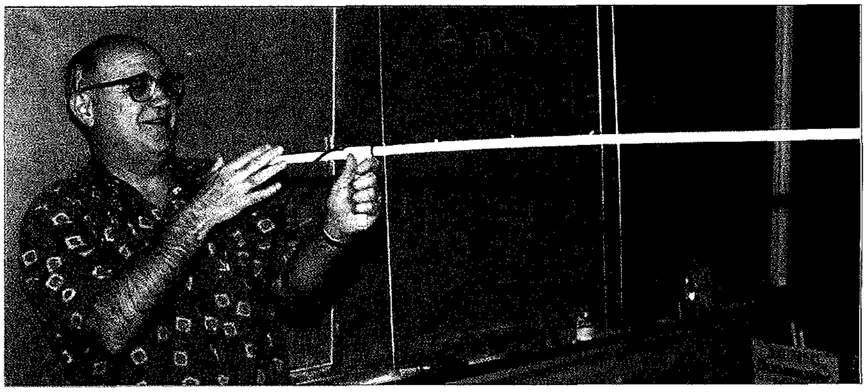


***Photo E**. The author demonstrating the use of one of the newly constructed fox-hunt beams.*

Simple Multi-use Amplified Speaker

J. Frank Brumbaugh KB4ZGC
P. O. Box 30 - c/o Defendini
Salinas PR 00751-0030

So you've built that nice kit transceiver, and you want to use it in your shack. You've got two problems right away. First, it was probably designed to run off batteries, and second, it probably doesn't have enough audio power to drive a speaker.

Many kits are designed that way to save money and to make them portable. The power supply and audio amplified circuits add weight, raise costs and create current drain that makes the units difficult to use in the field.

For everyday use, many hams add a regulated power supply and use their field units at home. The power supply doesn't solve the audio problem, however. If an audio amplifier and speaker is added to an existing receiver or transceiver it is not available for any other use. It cannot also be used on a different receiver, nor as a test speaker when checking designs of audio circuitry.

What is needed is a compact, lightweight, self-contained amplifier and speaker with volume control, and a headphone jack that can mute the speaker. It should be capable of producing normal room volume while requiring minimum current with no or minimal distortion. It should be capable of being powered by either an internal 9-Volt battery or an external 12-Volt battery or 13.8-Volt power supply. It should use few and inexpensive parts, and be easily constructed and used by any ham. The unit described here meets all these requirements.

"Self-contained, lightweight—it uses almost no power, yet you get wonderful sound! At home or in the field, you'll be proud of this project."

The Circuit

Fig. 1 is the schematic diagram of this amplified speaker. S1 is a SPDT toggle switch with a center-off position (on-none-on). In one position it connects the internal 9-Volt battery to power the amplifier. In the opposite position it connects the amplifier to J3, to which is connected an external storage battery or regulated power supply. When the unit is not in use, the switch is centered.

U1 is an LM386 audio amplifier chip in an 8-pin DIP package, wired to produce maximum gain at minimum current. In operation, low level audio is fed through J1 (audio in) through isolation capacitor C1 to the top of the volume control R1, a 10k audio-taper potentiometer. Audio taken from the wiper of R1 passes through isolation capacitor C2 and is applied to one input of amplifier U1. This input is lightly bypassed by C3 to prevent U1 from picking up stray RF, including that from any local AM broadcast station, and serves to stabilize the amplifier. Amplified audio is taken from pin 5 of U1 through coupling capacitor C7 to closed circuit jack J2 (PHONES) and then to the speaker, LS1. Mute the speaker by plugging headphones into J2.

Construction

U1 and associated components should be mounted on a small piece of perf board or one of the general purpose printed circuit boards available at Radio Shack™. C3 should be mounted with short leads between pins 2 and 3 of U1. Mount C4 at the end of U1, where pins 1 and 8 are located. Mount C6 with the shortest lead possible to pin 6 of U1. You may wish to use an 8-pin DIP socket for U1, but it is not necessary.

This unit should be constructed in the smallest case that will hold your components. The speaker should be small, yet have a large magnet and be rated for 1/2 watt or more. Recommended is a 1-Watt, 8-Ohm speaker intended for cellular phone use. It is 1.8 inches in diameter. Magnet diameter is 1.35 inches. It is available from All Electronics, P. O. Box 567, Van Nuys CA 91408-0567. The catalog number is SK-175. However, you can use any 4 or 8-Ohm speaker you have in the junk box.

A small aluminum box will make the best enclosure, but you can use a plastic box, or make one from pieces of printed circuit board material. You can drill a series of small holes in the circular area of the panel behind which the speaker will be mounted. You could also cut a circular hole for the speaker and use a piece of screen wire or perforated aluminum as a grille over the hole to protect the speaker cone.

Mount LS1, J1, J2, S1 and R1 on the panel. Mount J3 on the rear of the enclosure. Put rubber feet on the bottom to prevent scratches.

Battery BT1 can be mounted internally in a clip, or you can use self-adhesive strips of hook-and-loop.

Operation

Connect a source of audio, such as the output from the headphone jack of your receiver, to J1. Switch S1 to INT

to use the internal 9-Volt battery, or to EXT, if an external power source is connected to J3. Adjust R1 for a comfortable volume level from LS1. If there is too high a level of audio at J1, it should be reduced at its source. If you plug headphones into J2 the speaker LS1 will be muted, and you will have to reduce the volume level with R1 for a comfortable listening level. Because this unit is essentially noise-free, any noise you hear will be coming from the source plugged into J1, and will be amplified along with the desired audio.

When this unit is working, the LED D1 will be lit. When it's not being used, place S1 in the center (OFF) position; the LED will go out.

Using the internal battery, or with an external 9-Volts applied to J3, and no audio input, the amplifier draws 8 mA. With R1 fully clockwise (maximum gain) you will hear no, or almost no, white noise from the speaker or in the headphones using the internal battery for power. Any noise heard with an external power supply will originate in the power supply itself under these conditions.

With the audio level set at comfortable listening level, current drawn on CW or voice peaks can reach 50-75 mA. However, since this occurs only on peaks, the average current drain will be between one-third and one-half the peak current drawn on peaks while a signal is present.

Parts List

BT1	9-Volt Alkaline Battery
C1, C2	1 µF 16 V electrolytic
C3	470 pF ceramic disc
C4	10 µF 16 V electrolytic
C5	0.01 µF ceramic disc
C6, C7	470 µF 16 V electrolytic
D1	LED, color optional
J1	Mono phone jack, builder's choice
J2	Closed circuit phone jack, builder's choice
J3	DC jack, builder's choice
LS1	4 to 8 Ohm speaker (see text)
R1	10k Ohm audio taper potentiometer
R2	2.2k Ohm 5% 1/4W
R3	22 Ohm 5% 1/4W
R4	10 Ohm 5% -1/4W
S1	SPDT center off toggle switch
U1	LM386 audio amplifier

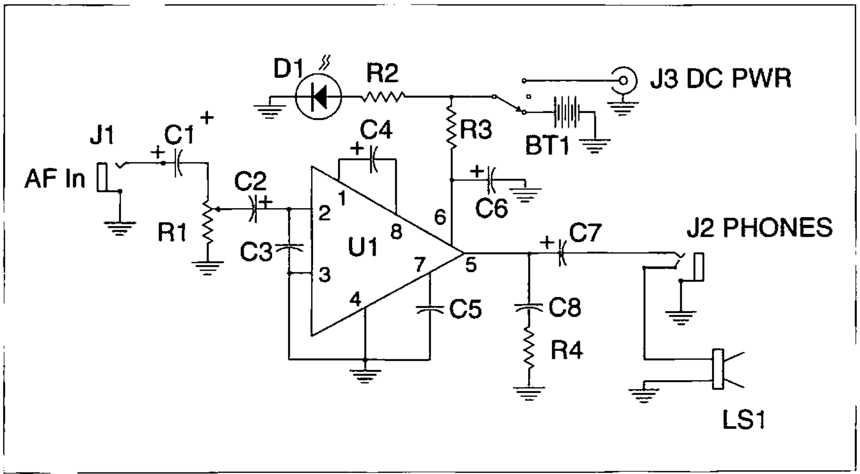


Fig. 1. The schematic diagram of this amplified speaker.

Transmitter Hunting Equipment

Continued from page 39

Active Attenuator Parts List

M = Mouser Catalog #

1	C1	112-100 pF trimmer M242-3610-100
1	C2	.0027 µF M140-PF2A272J
1	C3	.01 µF M140-PF2A103J
1	C4	330 pF M140-CA50P331K
1	C5	.1 µF M140-PF2A104J
1	C6	390 pF M140-CA50P391K
1	C7	120 pF M 140-CA50S121J
2	J1/J2	BNC chassis mount M523-31-221-RFX
1	L1	470 µH M43L0474
1	L2	3.3 µH M43L0336
1	Q1	2N2222A M333-KTN2222A
1	Q2	2N3094 M 333-2N3904
1	R1	3.3M30BJ250-3.3
1	R2	100 M30BJ250-100
1	R3	47 M30BJ250-47
2	R4/R5	1 M30BJ250-1K
1	R6	1 M31CN301
1	S1	SPST 108-MS550K
1		AAA battery holder M12BH410
1		coax jumper cable Jameco 102314
1		knob M45KN021
1		PC board FAR Circuits PAØZR board
1		project box Radio Shack 270-235

Note: 1) all resistors are 1/4 watt
2) potentiometer is 1/2 watt
3) AAA battery not included

FAR Circuits, 18N640 Field Court, Dundee IL 60118, 708 576 3540

Jameco, 1355 Shoreway Road, Belmont CA 94002-4100, 1-800-831-4242

How to Make an Old HW-8 Come Alive

New life for a vintage rig

Gerald F. Gronson K8MKB
3529 Belinda Dr.
Sterling Heights MI 48310

The next time you see an old Heathkit HW-8 at a flea market, grab it. With maybe an hour's work you can put some pep into this old "hot-water" baby and have fun. Here's how I substantially improved one.

In looking at the schematic, I could see that the receiver section was pretty good, but that the resistor and capacitor values were not the best choices. I could squeeze better performance out of this puppy.

Since the audio board (**Fig. 1**) was the easiest to get at, I started there. The output transistor was only loafing, so I changed C201, C204, R202, and R205 as per the parts change list to pep it up.

Having experimented with op-amp active filters, I thought the capacitor and resistor values of the stages built around IC2A and IC2B could be improved. Using a 750 Hz center frequency, the new R and C values brought the narrow filter section into alignment. The audio and RF gain controls now had to be turned down on loud stations.

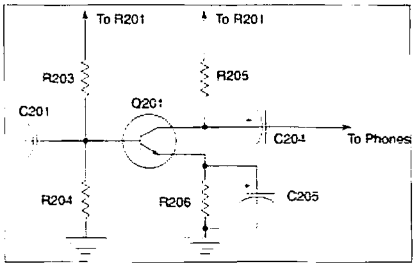


Fig 1. Audio board.

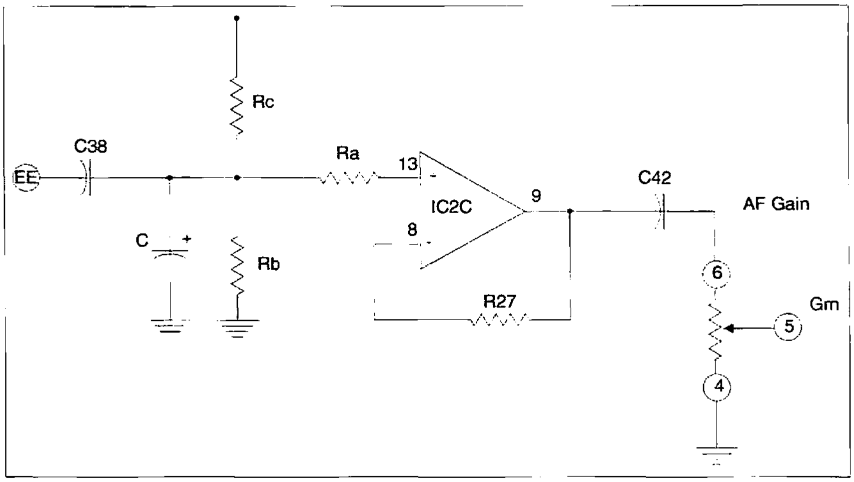


Fig. 2. Ra and Rb form a bias network for IC2C.

Hmm, let's see, what else could I change? IC2C looked like a good stage to fiddle with. What about C38 and C42? Yep, changing them helped a lot.

Next came the IC1 stage. I tried several values for R14, which had been 100 ohms, settling for 180 ohms. Increasing R14 much beyond 220 ohms causes oscillations.

One more stage to go. The RF amplifier was the kicker. Q1, #417-169, is an MPF105 — the worst possible choice they could have made for the RF amplifier. I replaced it with an MPF102, which is not the best possible FET to use. There are better transistors; however, the MPF102 *is* an RF type transistor and is a *much* better choice for Q1 than an MPF105. A coupling capacitor would be better than MPF105. For a good choice of transistors, see *The HW-8 Handbook*, by Mike Bryce WB8VGE. Mr. Bryce has a number of suggestions for making what amounts to a vast improvement in the Heath HW-8.

I suggest you change only two or three parts at a time, then put the rig back together enough so that you can turn it on and check its operation. Then proceed with the next three parts. This will ensure that if you make a mistake it will be easier to correct. Use a low-wattage soldering pencil and some Solder Wick to desolder the old components. A Radio Shack™ desoldering iron works just fine.

To reduce the internal circuit noise remove the 2.2 meg R26 and drill a little hole in the circuit board with an

X-acto knife where R26 was. Replace R26 with a tripod-like group of Ra-Rb-Rc (see **Fig. 2**). Ra should be the same value as R27. Replace R5 (**Fig. 3**) with R26.

The only other thing is to use a trimmer pot in place of R14 — a 1000 ohm value would do it. There is enough room for one and it makes it easier to adjust for optimum value.

I think you'll be happy with the receiver improvement and be able to have a lot of fun with this old rig. 73

Parts Change List

Part #	From	To
R205	1k	1.6k
C204	2 µF35 µF (optional)	
R203	47k	As necessary to adjust Q201 bias for best signal
C201	2 µF4.7 µF	
R202	4.7k 2.2k	
C42	2 µF4.7 µF	
R26, R27	See **Fig. 2** for bias network	
C38	2 µF5 µF	
C31	.1 pF	.05 pF
C36	1000 pF	1800 pF styrene or Mylar ™
R25	1m	1.2m
R24	82k	47k
R14	100 ohm	180 ohm or 1k trim pot
R5	100k2.2m	
Q1	MPF 105	MPF 102 If available, 2N4416 is better

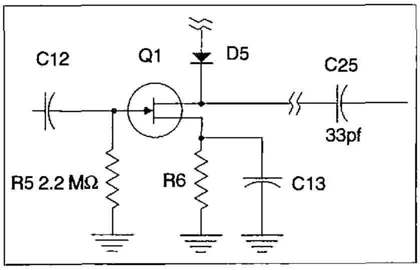


Fig. 3. RF amplifier.

Mikes and Match

Can an ICOM mike talk to a Kenwood radio?

Max Holland W4MEA
7333 Valley Lane
Hixson TN 37343

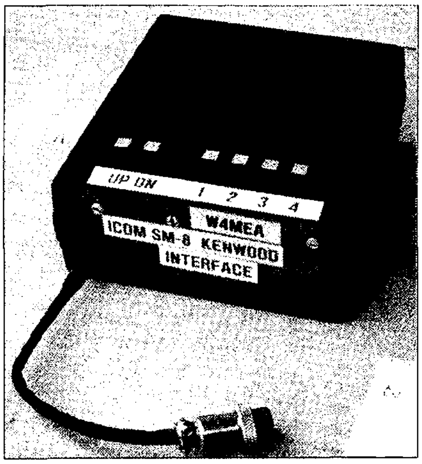
Pull up a seat and I'll explain how you, too, can interface just about any microphone to any rig. All it takes is the brass to outwit the manufacturers. For instance, let me show you how I got an ICOM SM-8 microphone to work comfortably with a Kenwood TS-50-S transceiver. This method can be used for interfacing just about any combination of microphone and radio.

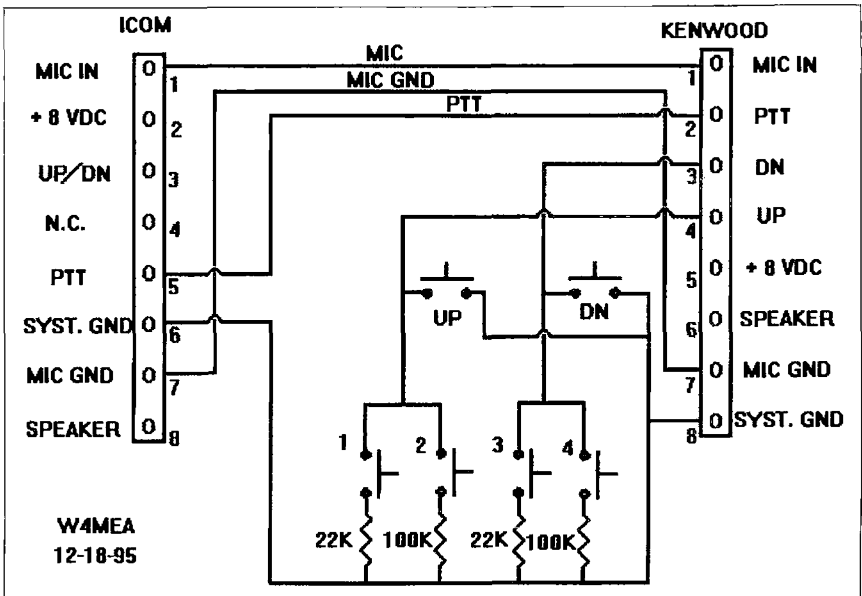
Microphones for Kenwood equipment, naturally, do not match the pin numbers of the ICOM equipment. You expected standardization? However, the voltages and operating characteristics are similar. The ICOM has two buttons on the base of the SM-8, but they do not match the UP/DOWN buttons on the Kenwood, so they are not used. The TS-50-S has an UP and DOWN button on the mike for changing frequency and four buttons for special features. So I built a simple interface box to take the place of the mike buttons and wired them so they'd be usable by the Kenwood.

This is an easy one-evening project that will cost maybe $10. Use some good quality push-button switches. The box can be plastic or metal; however, you want to keep the leads short, since the RF and AF will be close together. 73

Parts List

- 2 22k 1/2 watt resistors
- 2 100k 1/2 watt resistors
- 6 SPST Normally Open (N.O.) push-button switches
- 1 8-pin mike plug (to the Kenwood radio)
- 1 8-pin panel jack (from ICOM microphone)
- 1 Plastic or metal box





ICOM TO KENWOOD MICROPHONE INTERFACE

73 Review

Number 44 on your Feedback card

Build the Neat 2m Amplifier Kit

A great pair of shoes for your HT or data radio.

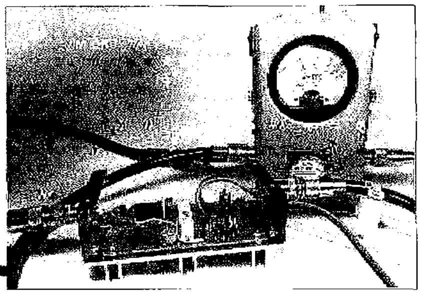


***Photo A.** Tuning it up to 35 watts, just like the specs promised!*

Bill Richarz WA4VAF
10035 Little Creek Road
Charlotte NC 28227

If you are using an HT or other low power radio for packet, you may want to try your hand at building this Ten-Tec 2-Meter Amplifier Kit. Even if you're not using your HT for packet, you can take the "scratch" out of your Handi-Scratchy so everyone will hear you full quieting, and love you for it.

Recently I acquired one of those low power data radios from MFJ. It did a fine job of receiving packet, but with only 5 watts out, there were too many Retrys. There were some stations I could copy well, but they were not hearing me. I needed a boost in power to eliminate the Retrys. Enter the Ten-Tec Kit. Ten-Tec, a well-known HF manufacturer, has a line of small kits in their new T-KIT Catalog. With an RF sensing TR switch and 20 to 35 watts RF output, I decided this little baby would fill the need *and* stay within the budget. Most of the 2 meter amplifiers out there are expensive and usually include a receiver pre-amp, which of course adds to that cost. Ten-Tec holds the price of this kit down by eliminating the pre-amp. Since most of today's 2-meter transceivers are quite sensitive, and the pre-amps sometimes only enhance any intermod, I decided to do without a pre-amp and save the money. The kit costs $74 and also comes assembled (for the lazy) for around $120. Here's where you can save some bucks, and have all the fun of assembling it yourself.

I feel many hams who were not around during the Heathkit era really missed out on the fun of kit building. To take a pile of parts, solder them on a PC board or chassis, and have the whole thing come to life...well, you can't imagine the feeling until you try it for yourself. After all, experimenting and building are an important part of ham radio.

Introduction

The T-KIT No. 1200 offers you the opportunity to construct, understand, and use an RF Power Amplifier for the 2-meter. The amplifier is designed for mobile, portable, and base station operation, providing over 30 watts of RF output, operating from 12-15 Volts DC. It comes with a detailed construction manual and all parts, including enclosure and hardware. Nothing extra to buy — well, almost nothing; they do *not* include those little rolls of solder that Heathkit builders had come to expect. So if you decide to build this kit, go out and buy a roll of 60/40 resin core solder, small diameter. Also, let me say here Ten-Tec does not project this Kit as "Super-Easy." This is a VHF construction project and attention is required in soldering technique and parts placement. Don't be intimidated, though. This can be your first kit, with the help of an Elmer with some experience. You should be able to complete this kit in a single evening. Before you get started, I would suggest reading the complete manual to familiarize yourself with all the parts and terminology used in construction of this kit. Also, you will need a few tools such as a 25-watt soldering iron, diagonal cutters, needlenose pliers, and a Phillips screwdriver.

"You can take the 'scratch' out of your Handi-Scratchy."

Circuit description

Q1 is a VHF RF power transistor operating in Class AB (See **Fig 1**). Bias is controlled by Q2, adjustable by 100-ohm trimmer R2. Q3 and its related components form an RF-sensing circuit which energizes the T-R relay during transmit only. When the relay is not energized, the input is shunted to the output, bypassing the amplifier circuit. This arrangement not only makes the needed antenna connection for receiving, but also permits normal use of the transceiver when the amplifier is turned off.

C5 is adjusted to peak the input circuit at the base of Q1, and C6 peaks the output at Q1's collector. L4 through L8 on the schematic diagram are striplines designed into the circuit board itself. The amplifier may easily be modified for Class C operation, if desired.

Getting started

While the manual provides step-by-step instructions, there are no illustrations other than the circuit board layout and an exploded view of the final assembly (**Fig. 2**). You should check off each step as it is completed in the boxes provided in the manual. Also pay close attention to the orientation of the banded cathode ends on the diodes as they are installed. The PC board is silk-screened with the

component outlines, making it easy to position them correctly. All parts are mounted on the top side of the PC board and soldered to the bottom, except for one transistor which is mounted on the bottom, so there is little chance for error. The one problem you might encounter is the winding of an RF coil. It consists of 12 turns of the supplied #16 enameled wire, close-wound on a standard 1/4-inch drill bit.

The kit may be built for class AB or class C operation, making it suitable for FM, AFSK, AM, SSB, or CW operation. I would suggest building it for class AB, then modifying it for class C, which is what I did. I later cut the two jumpers, making it a class C amplifier for use with my 2-meter FM packet station.

I had no problems mounting and soldering the components to the small board. On completion, it is a good idea to inspect the PC board for bridged solder joints, correct orientation of diodes and transistors, and correct selection of resistors and capacitors. Although satisfied that all parts were assembled correctly, I was a little hesitant in applying power for the first time. Ten-Tec gives no resistance measurements to check before the initial smoke test. I measured the resistance between ground and +DC connection and found it to be about 8 ohms. At least it wasn't a dead short. I hope they will add some resistance checks in later printings of their manual, to give the kit builder a bit more confidence before applying the voltage.

Final assembly and connection

The fully assembled PC board is mounted on the heatsink. End panels with the input and output connectors are also mounted to each end of the heatsink. Soldering the input and output capacitors C7 and C8 to the BNC and SO-239 connectors complete the electrical connections. The power cable is run through a strain relief grommet, then locked into place.

Adjustments

If you build the amp for class AB operation you must make an initial bias adjustment using your VOM. This is clearly explained in the manual. If

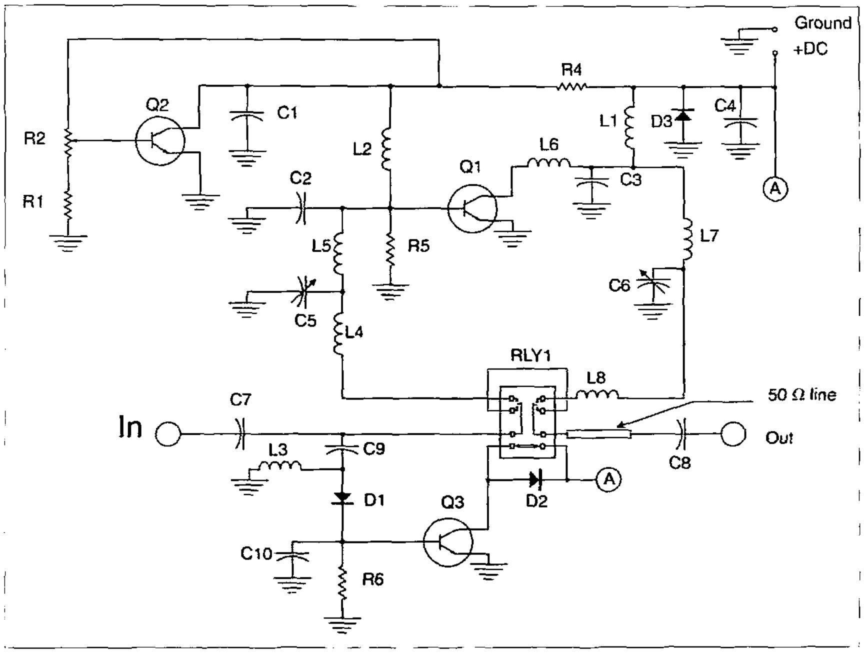


Fig. 1. Schematic diagram.

you built it for Class C only, then you may forget this adjustment. Connect a 50-ohm dummy load or 2-meter antenna to the SO-239 output connector through an RF wattmeter or SWR/wattmeter. Connect your low-power HT or other low-powered transmitter (five watts or less) to the BNC input connector. With RF applied to the amplifier input, tune the input and output capacitors C5 and C6 for maximum output on your meter. I was able to obtain 35 watts out. That completes the tune-up. Mount the cover on the chassis and you're ready to enjoy contacts that will hear you just as well as you hear them.

Conclusion

The Ten-Tec manual contains a troubleshooting guide that you probably won't need, but it's there, just in case. Its 26 pages include a circuit description and schematic diagram. Ten-Tec also has a limited warranty and a phone number for technical assistance should you need it. The back cover of the manual shows the resistor color codes and bits of other useful information.

I found this kit quite easy to assemble and had no problems — the amplifier performed as advertised and was fun to build. It doesn't have a large number of parts so it shouldn't overwhelm the new kit-builder. It completely solved my packet problem. It should also give the HT user quite a boost for the buck; no more, "Well, you're a little scratchy!" The only modification I would suggest is the addition of an ON–OFF switch. A Radio Shack™ illuminated switch mounted on the top side of the case will let you know when it's switched in or out, and allow you to run minimum power when high power is not required. Other than that, if you want to get your feet wet building a worthwhile project, I think you will enjoy building and using this 2-meter amplifier as much as I did, and you too can say, "...Oh yeah, I built that!"

You can get a free T-KIT Catalog by calling Ten-Tec at (423) 453-7172. T-KIT is a division of Ten-Tec Inc., 1185 Dolly Parton Parkway, Sevierville TN 37862-3710.

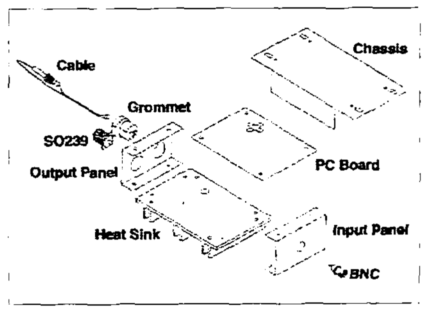


Fig. 2. Exploded view of the completed kit.

Tape-Wound Antennas
Continued from page 34

wave ground plane wires. These can be attached to the vertical using "T" fittings and 45-degree elbows.

It would be interesting to see some practical miniature beams built using TWAs. The effect of mutual coupling between elements would need to be looked into. However, TWAs would be ideal in constructing the high-performance but mechanically difficult W8JK type two-element driven beams with theoretical 5.2 dB gain over a dipole. This antenna can be set up based on resonance and symmetry.

Fig. 1 shows a suggested starting point. A typical design for 20 meters would have element lengths of 10 feet and a boom of 8 to 10 feet. Close-spaced beams like the above put severe demands on loss reduction since the radiation resistance is only a fraction of the radiation resistance of a single dipole. The TWA method is just the ticket. Rough calculations show that it should be possible to hold losses to about 1 dB with some end loading applied. This still leaves a net gain of 4 dB over a dipole, with full beam performance in all other aspects.

When capacitive end loading is applied, antenna efficiency will increase over calculated values, and would make an easy way of resonating an antenna wound a little too short. End loading can be applied by using plumbing Ts and placing copper foil on new short sections of pipe arranged at right angles to the dipole. These can then be soldered to the helical and adjusted for precise resonance, as shown in the photo for a 5-foot-long 14 MHz resonator. This is an extreme design with only about 50 kHz bandwidth. However, because of end loading it does achieve a more uniform current distribution and a relatively high radiation resistance which is estimated as about 2.5 ohms. Skin loss resistance is calculated as 1 ohm. Estimated efficiency is therefore still an astounding 71% (about 1.2 dB loss against a lossless dipole). Using a 3-inch pipe, losses could be halved but bandwidth would not significantly change.

A second method for enhancing radiation resistance and efficiency is by using wider tape in the middle of the dipole and transitioning to a smaller width toward the ends. This would be particularly effective with light capacitive loading. The current distribution would be flattened and resistive losses would be even lower.

A good rule of thumb is a physical tape length of one wavelength to achieve resonance for a uniformly loaded half-wave dipole. This rule gave very close results in all examples tried.

Multiband TWAs are also a possibility. The most straightforward approach would be to run two or more helical resonators in parallel, each wound for a particular frequency. The dipoles can be slightly turned between each other to avoid coupling, or be spaced a few inches apart. Unused dipoles simply become high Q chokes or capacitive elements. The antennas can be stacked using PVC plumbing components and cemented. It might be worthwhile to explore coaxial TWAs. Interaction between dipoles does not appear to create significant additional losses, a principle which can also be applied to the design of TWA multiband beams.

Remote tuning can be accomplished by moving an axial capacitive stub. The capacitive stub can be a flexible copper or steel wire wound and unwound on the inside center of the pipe. The wire is wound onto a metal pulley and shaft which is grounded to the center of the TWA. Little current flows so the arrangement is not very critical in terms of contact resistance. The PVC pipe provides a good seal to the environment. Either use a small motor or bring the tuning wire directly to the operating position. With a return spring, only a single mechanical control wire is needed. Teleflex type cables could be used. **Fig. 2** shows the functional arrangements. For small in-band changes, symmetry is not required. For symmetry and larger frequency changes, more elaborate tuning mechanisms can be devised.

The adhesive copper tape is readily available in major cities. I used 3M™ #1181. This tape has conductive adhesive. A non-conductive one is #1194. Both tapes have a 1.4 mil copper thickness. Skin depth at 14 MHz is 0.7 mils. Skin depth is inversely proportional to the square root of frequency so the tape could be used down to 7 MHz.

References:

1. *ARRL Antenna Handbook*, 1994.
2. *Reference Data for Engineers*, Eighth Edition, Prentice Hall 1993.
3. L.A Moxon G6XN, *HF Antennas* (Handbook), 1986 RSGB.
4. Glenn S. Smith, "Effects in Systems of Parallel Conductors" *Journal of Applied Physics*, Vol. 43, No. 5, May 1972.

LETTERS
Continued from page 25

summer in New England.

The telecommunications industry is growing very fast, and our company is expanding rapidly. We are hoping to make a breakthrough into the PCS market, which looks like a $5 trillion industry. It will make cellular telephones obsolete, and revolutionize all telecommunications. It was a combination of education, experience, and amateur radio which helped me land this position. Reading *73* magazine back in Germany from 1976-78 convinced me to go on for my electrical engineering degree, and to continue with amateur radio. Using your tapes and study material helped me earn my Extra Class license in 18 months. And that was before Bash and without any prior amateur radio training. This electronic knowledge and my enthusiasm for technical writing made me into a salable commodity.

It is difficult for the industry to find any competent telecommunications engineers who also have the ability to write a coherent declarative sentence. I urge you to continue to editorialize on the necessity for technical people to improve their writing skills.

Most of us have read about the excellent educational system in Japan, where they teach integral calculus to seventh graders, and have superb scientific training. What most Westerners overlook is that Japanese secondary school students spend an average of three hours a week studying liberal arts, including expository writing, calligraphy, and interpretive dance and music. This liberal education, coupled with their superior technical education, has helped make their nation a leader. We would do well to emulate their example.

Again, I wish to express my gratitude. This is the best job I ever hoped to have. Your generosity and kindness helped to make it possible.

Aw, shucks...Wayne

Michael Nie KB8VMX. Wayne: I read your "Welcome Newcomers" piece with interest. Many amateur radio publications have printed op-ed pieces or articles bemoaning the lack of activity in the higher classes of licenses. The two words at the top of the page, "*Radio Fun*," sum it all up. Amateur radio is a hobby. It is supposed to be fun. I can only speak for myself, but I feel

Continued on page 82

NEVER SAY DIE

Continued from page 35

heart attack or stroke.

If you have any chronic illness, that's a powerful indication that you haven't been taking proper care of yourself. Lousy food, ingesting poisons, too little exercise and sun, too much stress. The route I'm promoting is one where your work will be so much fun that you'll never really think of it as work. Why do you think I publish a ham magazine? That's nirvana for a dedicated ham. I get to visit hams all around the world. I go on DXpeditions. I get to check out the latest ham gear. It's a life of adventure and fun.

When I published a music magazine my "work" involved listening to the new CD releases of my choice, visiting recording sessions almost anywhere, and so on. Talk about fun for a music-lover!

What is the most fun job that you could have? If you could live anywhere and do anything you wanted to make money, what would it be? I'm living on a farm in New Hampshire, where the air is always fresh, the water superb, and the taxes low. Exercising is a delight. Watching a whole bunch of deer feeding around the house is exciting. Shhh, please don't scare them away.

When you run your own business, if it's at all successful, your paycheck is whatever you want it to be. I paid myself over $500,000 a year for a while, but I got tired of paying the income taxes on all that. I didn't have any big personal need for money, nor the time or interest in taking care of it through investments. But then I've never done anything because it might make money. I do the things that are fun to do, that I think need to be done, and I try to do them so they don't *lose* money.

Sure, I want to get more subscribers for *73*, but that's because I want to try and help more readers have fun and learn things. If I can get you to elmer more new hams I'll have more readers and we'll all have a little more clout with the FCC when they start wanting to sell off our most valuable microwave channels. If I get more subscribers and thus attract more ads, you'll get a fatter magazine.

But it is nice to at least be able to buy the things you want without wondering how you can pay for them. Or to zip over to Paris or Hong Kong when you feel like it.

Well, that's enough for now. I don't want to totally ruin the sales of my $5 book *Making Money, A Beginner's Guide*. You now have the first lesson, which is to realize that you don't need a college education in some field to be successful. The next step is to figure out how you can learn what you need to know for a fun career at the lowest possible expense to yourself, and how to do it in the shortest time. When I started my first entrepreneurial business I was a millionaire within two years.

A baudy bunch

With most of the new TNCs including 9600 baud, I'd like to publish more info on this. For that matter, with Internet connections being considered slow at 14.4, there must be some interest in stepping up packet speeds. Let's (a) start doing it and (b) writing about it.

How about HF packet? What progress is being made in speeding it up and what are the problems involved? What do we have to do, start using the Internet for long-haul packet trunks?

How about Macs?

A letter from Jason Spitzer KD6HYB grumbled about the almost total PC and Windows orientation of ham computer stuff these days. Since I just bought a stupid PC so I could check out some of the stupid Windows CD-ROMs, I can only attribute the world's PC fixation to ignorance. Or misplaced thrift. Sure, Apple charged ridiculously high prices for their stuff. It made for great profit margins, crummy sales volumes, and a lousy market share. Now that the Apple share of the market has shrunk from 40% to around 10%, I can understand the revolving door to the management suite.

When Apple lowered prices their sales volume zoomed

Continued on page 55

Simply Portable

An easy way to operate in the field.

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Brainerd MN 56401

Often when planning portable operations, whether for Field Day or an actual emergency, we need to operate on the HF frequencies. Power for modern HF rigs isn't much of a problem, but the antenna can be. Some of the solutions that we've heard suggested include:

(1) Use a mobile antenna. It isn't as efficient as we might want, but...

(2) Hang a dipole between a couple of trees. There are no trees at the site but that's okay because the guy with the bow and arrow or whatever left it at home anyway...

(3) Put up a vertical and guy it to some stakes driven into the ground. Not a bad idea, unless your site happens to be in the middle of a frozen lake or a paved parking lot. Besides, someone is bound to trip over, or worse, for the antenna, *drive* over one of the guy ropes. There is also the problem of underground utilities which may not be as *far* underground as we might think.

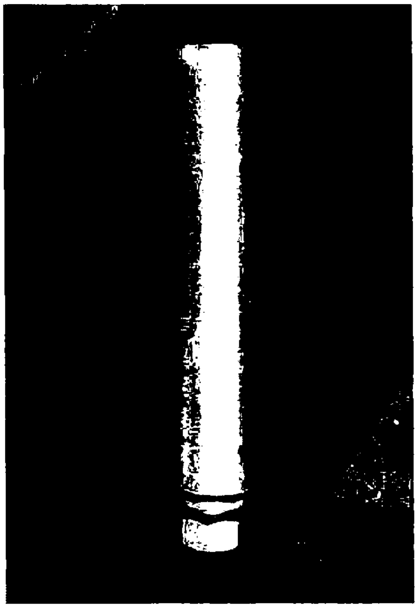

Photo A. *Neat and discreet. The finished mobile mount.*

"Armed with this gadget and a few wrenches, one person can have a 27-foot vertical out of the car, assembled, and erected in a very few minutes."

I liked the vertical idea. I use a ground-mounted vertical without much of a ground plane at home so I decided to see if I could figure out a way to mount it in the field. I wanted something that was solid, safe and easy for one person to put up. And I did *not* want to have to drive any stakes or dig any holes.

The solidest thing I'm likely to have with me in the field is my old station wagon. Unfortunately, the solidest part of my old station wagon is the trailer hitch. After a bit of head scratching I came up with the simple solution. The junk box provided a nine-inch length of 1-5/8" o.d. pipe, the hardware store provided a 3/4" by 3-1/2" bolt and two matching nuts. Our club VP, KAØJSW, did the welding. The photos and **Fig. 1** show that this *is* the simple solution. Armed with this gadget and a few wrenches, one person can have a 27-foot vertical out of the car, assembled, and erected in a very few minutes. Even if you plan to operate from inside the car, where you might normally use a mobile antenna, the vertical should prove to be more efficient. After watching me set up at a recent hamfest, several people were sufficiently impressed to say they planned to make a similar mount for their "get-n-go" kit. "Just in case." If the junk box ever produces a 3- or 4-foot piece of pipe I may make a taller mount to get more of the antenna clear of the car body, but for now, this is simple. I may also weld some kind of crank or handle on the 3/4-inch mounting nut to avoid having to carry around a heavy, expensive wrench.

Photo B. *Locked on and ready to rock 'n roll!*

HAMS WITH CLASS

Where In The World Are We?

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

The world comes alive in the classroom with amateur radio! My radio courses for 6th, 7th, and 8th graders give me the opportunity to teach geography skills on a need-to-know basis. There is nothing more natural than locating a spot on the map to discover where the voice you're hearing is coming from.

Geography skills are an intrinsic part of the bonus package that young hams get every time they make a contact out of their local area. The youngsters benefit in so many ways by becoming more geographically literate. Impromptu discussions take off after the simplest DX contact. For example, one of the best units on Central America came about after a contact with a ham in Belize.

Discussions about history, economics, government, climate, and culture went on for days in my class. I had the children designing travel brochures and creating bumper stickers. One of the cleverest slogans was, "Without geography, you're nowhere. But with geography, you're everywhere."

My suggestion to any teacher incorporating radio into class lessons is to coordinate lesson goals with a Social Studies teacher. Your school administrators will love the idea of the "team" approach to teaching, the Social Studies teacher will become enchanted with the idea of speaking directly to people from around the world, and the children, of course, will have fun while they're learning.

Every year I add at least three new resources to my Geography multi-media center. Here are some good ones that might be worth your while to pursue:

1. *Geotopia*- This booklet allows students to create their own imaginary country, including climate, crops, culture, physical features, and more. *Geotopia* is published by USA Today Educational Programs. Student copies are 35 cents each. Free teachers' supplemental materials are included. For more information call 800-USA-0001.

2. *Somewhere In the World Right Now* - Through this story book, take a look at what individuals are doing simultaneously in different time zones around the world. Written by Stacey Schuett, this 1995 release is published by Knopf for $16.00. (ISBN 0-679-8537-3)

3. *Cross-country USA* - Diatech Software has designed this elementary level software. The program, available for both PC and Mac, introduces children to U.S. geography. School editions, lab packs, and site license versions are available. For a free demo disk, contact Brian Selstedt at 800-665-0667.

4. *Kid's PACK* and *Teen PACK* - Zero Population Growth has put out two new programs for middle school and teen students. PACK stands for Population Awareness Campaign Kits. They include hands-on activities in a colorful format. These free programs can be ordered in bulk by teachers. Contact Pamela Wasserman, Director, Population Education Program, ZPG, 1400 Sixteenth St. NW., Washington DC. 20036.

5. *Material World* - Software lets you experience local customs, indigenous music, prized possessions, and the laughter and tears of people around the world by looking at the lives of thirty typical average families. Families in Kuwait, Thailand, Mali, and Sarajevo are but a few viewed. Software comes in both Mac and PC versions. For more information contact StarPress Multimedia at 303 Sacramento Street, 2nd floor, San Francisco CA 94111 or call 800-782-7944.

Remember, the most important thing you want to do is to convey a sense of genuine excitement about reaching out to other people all over the world through amateur radio. Have fun!

***Photo B**. Some of our best Geography projects have come about after a DX.*

***Photo A**. Children enjoy locating the source of the radio voice.*

Number 50 on your Feedback card

73 Review

The DVR-1 Digital Voice Recorder

Bill Clarke WA4BLC
764 Altamont Voorheesville Road
Altamont NY 12009

Hamtronics' easy-to-build DVR-1 Digital Voice Recorder kit was initially designed for IDer use in repeaters. The recorder does, however, have several other applications for the ham as an adjunct for SSB operation. Here's an introduction to the DVR-1, as a kit, and some generic connection information for its use with SSB transceivers.

The DVR-1 is a digital audio recorder that allows 20 seconds of recording time; you can transmit a previously recorded message at the press of a button, record incoming audio for instant playback, or retransmit previously received audio.

Why would you want to transmit a previously recorded message? Just think of how many times you might say "CQ CONTEST...CQ CONTEST...CQ CONTEST" during long hours of operation. Save your voice!

Heard a weak one and didn't quite catch the call? Press playback as many times as you need and listen, over and over, until you figure it out. That was a 59 report, wasn't it?

Ever been asked by the local microphone adjuster, "How's my signal now?" Just record the received audio and transmit the playback. Let the sender be the judge!

The DVR-1 can be bought as a kit or as an assembled-and-tested printed circuit board ready to connect with your station. I recommend the kit, as it will save you about forty dollars and will only take an hour to assemble.

The kit I assembled uses sockets for the ICs, and has ample space for all components. The circuit board is double-sided and made of high quality Fiberglas™. The layout is easy to work with; the assembly instructions are given as steps, and warnings are clearly marked for components that must be oriented in a specific manner, such as diodes.

Be sure you use a low wattage soldering iron during assembly. My personal favorite soldering tool for small projects is the Isotip rechargeable with a fine tip, available from MCM Electronics. It is lightweight, easy to handle, and is a low wattage unit that will not harm the foil on the printed circuit board. Use solder sparingly and carefully clean away any solder bridges or globs of flux.

The completed DVR-1 is meant to be installed inside a repeater; however, for use as a station adjunct for SSB, you will need a project box. Project boxes are available from Hamtronics, as seen in their catalog, or from Radio Shack™.

Use a project box large enough to hold the DVR-1 plus a few panel controls on the front and/or top and connection points on the rear. You will need rubber feet for the bottom and labels for the controls.

I chose to make my installation as simple and easy to use as possible. The project box I used was the TP43 (2.5 x 5 x 5 inches) from Hamtronics. This is a little larger than necessary, but it sits firmly on my desk (this project doesn't weigh very much). The DVR-1 circuit board was installed using standoffs and screws. It could as easily be mounted using silicone glue and short pieces of doweling for standoffs.

I installed my controls on the top of the box, so I wouldn't have to play tag with the box each time I pushed a button. The controls consist of an on/off switch, a momentary contact push-button for RECORD and the same for PLAYBACK. There are two toggle switches—one to select audio input source (internal mike or receiver audio) and the other to select audio output to the transmitter's mike line or to an external speaker and control PTT switching. Internally, I installed a small 5V DC relay to key the PTT line when I wanted audio playback to be transmitted.

On the front panel is a 12V DC pilot light and a one-inch hole to allow use of the DVR-1's built-in microphone. The mike could easily be mounted on the front. On the rear panel of the project box are four RCA jacks; for 12V DC power, audio input from the receiver, audio output to the transmitter, and the transmitter's PTT line. A pair of insulated screw terminals are used for external speaker connection. The internal connections are made to the DVR-1 circuit board per instructions in the manual.

Hamtronics provides a thorough manual with the DVR-1. It shows the method of construction and how to connect simple divider circuits for audio input and output, fully explains operational theory, and gives examples of circuit enhancements.

An interface circuit was built for audio input from the receiver, the small relay was connected to a pad that provides +5V DC during playback (normally open contacts actuate the PTT line), and the playback audio connected to the transceiver's mike input line. The RECORD and PLAYBACK switches are tapped into the DVR-1 circuit board in parallel with the existing switches.

Check the operating manual for your particular transceiver for details about circuit interfacing and connection points. Do this carefully to assure proper connections — so no damage to either device occurs. 12V DC power can be taken from your station power supply or tapped from a transceiver.

To check the DVR-1's operation, switch to the internal mike, press RECORD and speak. Using speaker output, press PLAYBACK. You should hear what you just recorded.

Receive audio is easy to interface with the DVR-1. I used a Y-plug adapter at the transceiver's external speaker jack, sending one side of the audio to the external receiver speaker and the other to the DVR-1. The constant level audio output of a transceiver could also be used, if available. Some adjustment of

the divider circuit you built inside the project box will be necessary to prevent overdriving the DVR-1. Recording is done by pushing the RECORD button and playback by pushing the PLAYBACK button. Playback will be through the speaker connected to the screw terminals on the rear of the project box.

To send a recorded message, such as a CQ, switch the audio output to the mike line (which also activates the PTT line on my unit). Record a message as you previously did. Press PLAYBACK, which will key the transmitter and play the message through the transmitter's mike circuit. Adjust output level as necessary. Recording off-the-air and instant playback are merely combinations of these two operations.

Other configuration options

Instructions are given in the operations manual for more complex setups, such as splitting the 20-second recording time into smaller time blocks. This allows the choice of more than one prerecorded message to be transmitted, by operator selection—an ideal setup for contesting.

Beacon ID can easily be accommodated using the DVR-1. The internal timing circuit can be used to activate the transmitter and play back the recorded message. The timing circuit can be changed to provide any desired timing interval.

The DVR-1 can be used anywhere instant audio recording and playback is needed, or where there is a requirement for playback of messages at prescribed time intervals. I can see applications in stores, warehouses, and in theft/intrusion alarm systems.

The Hamtronics DVR-1 is available for $59 in kit form or $99 assembled and tested. Contact: Hamtronics, 65 Moul Road, Hilton NY 14468-9535. Phone (716)392-9430 or Fax (716)392-9420. Ask for their catalog—it has lots of nice projects for radio hobbyists. 73

Ask Kaboom

Number 52 on your Feedback card

Your Tech Answer Man

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Mail call!

Well, the mail has been accumulating, so it's time to dig in and answer some questions. Before I do, though, I want to add something to the series on repairing computer monitors that we wrapped up in the April issue.

I stated that just about any horizontal output transistor could be used in most monitors. For the most part, that's true, but there is one consideration I forgot to mention: Some transistors have integral damper diodes and some don't, and never the twain should mix.

What's a damper diode? If you look at a TV schematic, you'll see that the horizontal output transistor pulls current through the low-voltage, high-current side of the flyback transformer. Even on the low-voltage side, though, there could be anywhere from 20 to 100 or more volts. The inductive spike which occurs when the transformer's field collapses can be tremendous. It can induce "ringing" in the coil, resulting in a disturbance in the horizontal scan. It can even be enough to damage the transistor. So, all TVs always have a damper diode which is reverse-connected across the transistor and damps out the ringing. In the tube days, there was a damper tube. When solid-state parts took over, a fast-recovery diode did the job. These days, the damper may still be a diode on the board, but it can also be inside the horizontal output transistor itself.

For instance, a 2SC3486 doesn't have a diode, while a 2SC3893A does. If the original transistor had a diode, you must use a replacement that has one, too. Can you replace a non-diode transistor with one that has the diode? Logic suggests that having two diodes in parallel (which is what you'd wind up with, because there'd also be one on the board somewhere) should be OK. In all fairness, though, I haven't actually tried it. To be safe, just use a compatible transistor with the same diode arrangement.

Let's dig into the ol' mail bag!

Dear Kaboom,

I've always had a dream of building an HF amplifier from transistors. I'd like to construct an amp using 24 2879s. I figure 24 120-watt transistors would give me a sturdy 1.5-kilowatt amp that would loaf along quite nicely, yet I can't find any construction articles or books for making such a beast. Where is the information? Who might I ask? Where do I look?

Signed,
Warm Up The Iron

Dear Warm,

Good question! There are a couple of commercially available, solid-state amps, but the technology has not yet become commonplace. I suspect it's mostly due to cost. Why should a solid-state amp cost so much more than a tube amp of equivalent power output? Well, you can get one heck of a lot more power from a single tube than from a single transistor. So, you have to use a lot of transistors, as you pointed out, in order to get the kind of output you could obtain from a tube or two. Really, it isn't the cost of the transistors themselves (although that's not insignificant) which makes the amp so expensive. Rather, it's all that coupling! How the heck are you going to couple the inputs and outputs of 24 active elements so that they all stay in phase and share power equally, especially at radio frequencies? It can be done, but it isn't easy, and it requires lots of windings on a big RF transformer, and plenty of heat sinks and equalizing resistors. Also, provision has to be made for enough isolation between the transistors to avoid a mutual disaster should one of them short out.

Then there's the matter of the power supply. The high-voltage, medium-current power used by tubes is fairly easy to obtain from ordinary 120- or 220-volt wall current. But where are you going to get, say, 14 or 28 volts at 100 to 150 amps? That's a lot of current, and it'll require not only a very big power supply — even with a switcher, we're talking some iron — but also extremely thick conductors to the transistors or whatever feeds them. You just can't pump that kind of current through #14 wire!

Power MOSFET transistors are easing the problem somewhat, because they can work at higher voltages (and thus lower currents), and can produce a fair amount of power per transistor, meaning you have to use fewer of them. So far, though, nobody is producing transistors with the power output of even a smallish tube like the 3-500Z.

If you really want to build a legal-limit, solid-state amp, go for it, but be aware you're facing a difficult task. I don't know where to tell you to turn for construction information, but if any of you gentle readers can advise, I'll publish the info here in the column.

You also mentioned you might like to build a tube amp. For that, the *ARRL Handbook* should be quite helpful. True, it's not a compilation of amp circuits, but there should be enough in there to get you going, and you can develop your own modifications to make the amp into what you want. I wish you the best of luck in your amplifier projects.

Dear Kaboom,

The LCD on my ICOM IC-02AT conked out. It is blackened about 90 percent, but I can't see any other physical damage. Could something be wrong with the radio's circuitry? The rig works fine otherwise. Can I replace the display? What is involved with that?

Signed,
Squinting

Dear Squint,

No, there's nothing wrong with your radio's circuitry. I've seen this happen before, generally on older radios. In fact, my car stereo's display is slowly going the same way. It's caused by loss of the seal on the edges of the display, causing the two glass plates to separate slightly. That lets the liquid-crystal material flow, leaving areas where there is none. The result is a black display, even when the radio is off. The only fix is to replace it. If you're handy at taking equipment of this scale apart, you should be able to replace the LCD fairly easily. Many LCDs are held in place only with pressure, either from a bracket attached to the PC board, or by the radio's case. Contact is made via a special conductive rubber ribbon. Other displays have regular solder contacts which will have to be desoldered from the board. I don't know which method the 02AT uses, so you'll have to open it up to find out. As for obtaining the display, you'll need to order it from ICOM; such displays are all custom-made for different radios, and you can't get one at your local surplus house. By the way, if you find any of the liquid-crystal material leaking out from the display, *don't touch it—it's poisonous.*

Dear Kaboom,

I know this is a little bit off the ham subject, but the CD-ROM drive in my ham shack computer is acting up in a strange way. It has trouble reading a disk, especially at the beginning. Sometimes it'll read it, sometimes it'll just give up. It won't read some disks at all, while others usually work. It seems to be getting worse. Any ideas?

Signed,
No Drive

Dear Drive,

If you've been using the drive in a very dusty environment, or you're a (gasp) smoker, it's possible that the lens has become dirty. There are special lens cleaning disks which can clean it for you. I suspect, though, that the real problem is that the optical pickup head in the drive is failing. I've seen many audio players with the problem you describe. Unlike LEDs, laser diodes have a finite life; they gradually get dimmer and dimmer until there's not enough light for the player to

see the disk. Because reflectivity of CDs isn't perfectly uniform, some disks work better than others when the beam is marginal. Eventually, it'll get so dim that the player will cease to function. Although it is possible to replace the head, it's rarely worth it, because the part costs more than an entire new player! Besides, alignment is tricky; you really have to know what you're doing, and an oscilloscope is mandatory. I think you need a new drive.

Well, that's it for this month. Until next time, 73 de KB1UM. 73

Number 53 on your Feedback card

Above & Beyond

VHF and Above Operation

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Test equipment and frequency counters

Last month I described some of the methods used to form an interest group for the VHF/UHF/SHF frequency bands. I described several of the steps our group went through, in order to assist you in putting together a similar group. This month, let's get into some of the tougher issues, like what test equipment is needed to perform modifications and tune up equipment. This step is to further assist your group's technical needs. Having some basic microwave test equipment available is crucial.

"We are starting to see inexpensive frequency counters good to 2 GHz."

With any microwave group or society formed, there must be a source of test equipment available to help solve the technical problems of the group. For those of us who started our amateur operations with much simpler modes, and even with vacuum tubes, test equipment was just as viable then as it is today. In those early days test equipment was limited to Eico or Heathkit commercial kits of o-scopes, signal generators, voltmeters, and various SWR and assorted station accessories. Also available was equipment from military surplus or, more properly, World War II and later surplus material.

I remember many days of converting ARC-5 transmitters that used 1625 tubes in the final for CW operation on 80 and 40 meters (a 1625 is a military version of a tube familiar to many old-timers, the 807). However, I don't want to get hung up on converting ARC-5s as I reminisce on the meager equipment collected at that time to test and make functional early projects (I would really like to find a clean ARC-5 for Memory Lane). The test and alignment equipment needed today is more exotic and a far cry from our early frequency meters.

Frequency counters

It doesn't take much to remember a frequency counter that counted up to 1 MHz (HP-523), and a much sought after frequency counter that made it to 10 MHz directly and ultimately to 500 MHz with appropriate plug-in converters. Did I mention that the HP-523, weighing in at 60 pounds and made for rack-mount, sported several handles to allow moving it? Did I have these units in my shack in the 60s? Yes, plus a small cart to move them.

We have come a long way in test equipment development, not only in military models but in civilian models as well. We are starting to see inexpensive frequency counters good to 2 GHz, and to hear about some models on the drawing board good to better than 10 GHz. Surplus counter types that go to 50 to 300 MHz and have plug-ins to extend that range up to 18 GHz are now commonly available. There are direct-reading counters that count to 18 GHz. Needless to say, these are some of the more expensive counters available on the surplus market.

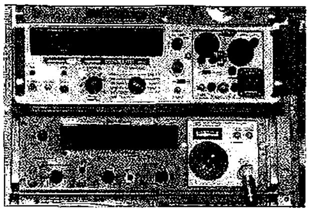

Photo A. Two older HP frequency counters: the Systron Downer 1037 counter with a transfer oscillator that goes to 18 GHz (top unit); and the author's HP-5245 workbench workhorse with a 3 to 12.4 GHz plug-in.

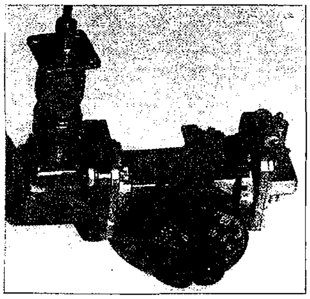

Photo B. The author's 10 GHz Gunn oscillator (10 mW) waveguide attenuator and coax transition, forming a 10 GHz signal generator for bench tests.

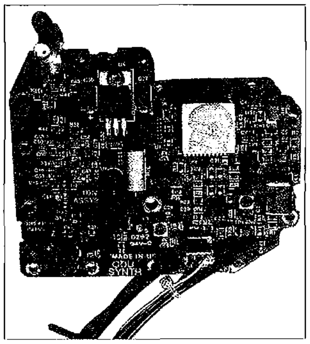

Photo C. A Qualcomm phase-locked loop VCO-controlled synthesizer. This functions one point frequency between 2 to approximately 3 GHz, but normally resides near 2.6 GHz. It can be pin-to-pin programmed, or you can use an IBM bus.

There are several different surplus choices that can be taken advantage of when you locate them. What I want to do this month is give you some guidelines on what surplus frequency counters are available today and cover some of their capabilities. Also, I want to discuss some of the newest amateur market frequency counters that are now being sold. Coverage will be limited to ease of operation, frequency coverage, frequency accuracy and, finally, cost, to give you some benchmarks to help you make up your own mind.

What are the main differences between surplus and new frequency counters? Mostly, weight and cost. Surplus counters are typically heavy and seem to cost more. Why consider a heavy and more costly counter vs. a newer, smaller, battery-operated, less costly one? To answer this question you have to ask yourself a question: What do you expect from a counter? What frequency ranges are required and to what accuracy must this measurement be relied upon?

The answer: If your frequency measurement requirements do not go over 2 GHz and the accuracy needed is average, I suggest purchasing a small battery-operated counter. There are many different models available from Startek, Ramsey, Digimax, Optoelectronics, and many others that will fill the bill very nicely. The Startek Model ATH-50 is quite nice and has a top frequency limit of 2.8 GHz (2,800 MHz) and an LED bar graph showing signal level. All those features for only $339—quite a deal.

The frequency accuracy of most of these frequency counters is in the order of 1 ppm. What that means is 1 hertz of possible error for every megahertz of frequency being measured. If we were to measure a 2 meter HT, for instance, our possible error at 2 meters would be 150 hertz of uncertainty. Most manufacturers make a high accuracy time base that is an extra add-on feature, making their frequency counters more accurate. For instance, Startek's option #HST-15 costs $125 extra, and its high accuracy "Temperature Controlled Crystal Oscillator" (TCXO) time base upgrade increases accuracy to ± .2 ppm.

Operation with a TCXO is transparent to you but allows the internal crystal reference to the counter to be controlled by a higher-accuracy time base, increasing accuracy in your measurements. Going to a .2 ppm time base TCXO oscillator would reduce errors at 2 meter (150 MHz) measurements to 30 hertz.

In practice, it's not quite that pure because the error is not a perfect 150 hertz or so. The uncertainty factor is a ratio somewhere around this number. It could be high or low depending on when the last calibration was done using WWV or some other calibrating method.

Now enter the microwave scenario. How do you measure frequencies over the range of the portable counter? Well, there are several methods, one being a surplus frequency converter (the HP-2360). This unit mixes a known harmonic whose fundamental frequency is in the 200 to 300 MHz range of the unknown microwave frequency. Make two to three measurements to find a harmonic that is nearly 60 MHz apart. After you determine what two fundamental frequencies, multiplied by the harmonic number, produce this 60 MHz separation you will know the microwave frequency exactly. The 60 MHz separation is due to one frequency going 30 MHz high and the other going 30 MHz low, resulting in a difference of 60 MHz. The method is a little cumbersome but does work.

Other frequency counters to look for in surplus are Systron Downer and Hewlett Packard units. I happen to have, for test evaluation, both the Systron Downer and Hewlett Packard counters. These all run from AC mains and are a little on the heavy side. **Photo A** shows both counters with their respective microwave frequency converters (plug-ins) in place. I like the Systron Downer as it can be set up to generate a weak signal on a frequency for marker use, while the HP does not leak a sample of the harmonic through the converter front end.

What makes these large commercial frequency counters still popular? The accuracy is quite a bit better and the frequency capabilities can go to 12.4 or even 18 GHz with readily available plug-in converters. Frequency accuracy is tighter as this type of counter uses an internal oven-controlled "high accuracy standard." How accurate? Using a counter with an accuracy of 1 ppm would give a 10 kHz possible error in your frequency at 10 GHz. Now, if you're looking for weak signals, this is a wobble in your cog and needs to be addressed.

Normally these units have an oven-controlled crystal oscillator that can be calibrated to a few parts in 10 to the 8th power—that's .01 ppm. Now, with the appropriate converter plug-in attached into the counter we will measure a 10.368 MHz frequency with a possible error of 100 hertz. With a few extra tricks it gets even better when you connect to an external frequency standard capable of higher accuracy. My external master standard (really my garage standard) is an FEI-10A capable of producing a 1 MHz oscillator which is accurate to .0001 hertz at 1 MHz. That is the same as .0001 ppm, and it's not worth figuring out the error, as that's about as good as it gets in amateur circles.

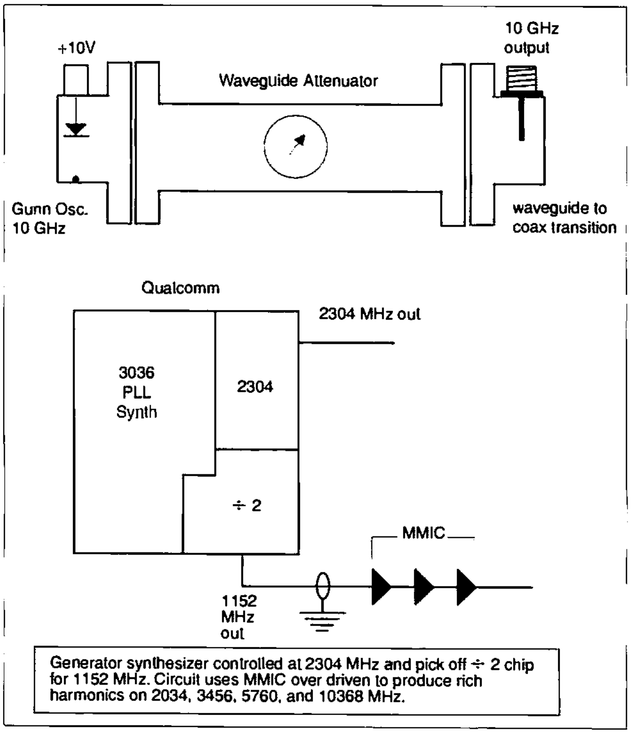

Fig. 1. *Schematic of a simple microwave test generator.*

"The most important piece of test equipment is the microwave power meter."

Now comes the tough question: How do you convince someone that their calibrations made with WWV at 10 MHz have little to compare with the measurements you just made with your Garage Standard? Measurements based on WWV accuracies are good to about .1 to .01 ppm at best, due to the Doppler effect. Doppler shift affects the path over which the highly accurate clock at WWV (the source) must travel before you receive it (2.5 MHz and up). Sure, at the source it's accurate to .000001 or better, but the accuracy changes at your receiver due to the transmission path Doppler effect on the low to high MHz frequency bands.

A very high accuracy reproduction of WWVB can be received at 60 kHz due to minimal Doppler problems at this low frequency. This is the same method that I, and calibration labs, use. This is the "traceable path from your standard to WWVB's national standard when so calibrated." Well, so much for counters and accuracy. Let's get on to what other test equipment is essential for microwave tinkering.

Power meters

The most important piece of test equipment that should be in any modest ham microwave workbench is the microwave power meter. This piece of test equipment is the single most used item in my shack's workbench, along with a set of attenuators to extend its range to higher power. I have written several articles on both the General Radio and Hewlett Packard power meters and don't express a preference. The most important thing is to have some means of discerning microwave power at very low levels in order to be able to perform modifications and circuit stripline tuning. Sure, a spectrum analyzer is very nice in this application as it will show you what is actually going on. For the broad picture the spectrum analyzer is paramount. But for fine adjustment response the microwave power meter will show you .1 dB increases with ease where .5 dB increases are about the best you can see on a spectrum analyzer available in the amateur's grasp. New spectrum analyzers with digital readout are available with better readout, but (gasp) the *price!*

Other test equipment

What items would I place on a shopping list to add after the power meter? I would suggest a simple test generator and attenuator setup to function at your desired test frequency so that you would be able to generate and detect the frequency of interest. The frequency generator doesn't need to be a full relay rack signal generator; it can be a simple free running or synthesized source that can be controlled. By that I mean a shielded source and one that is somewhat reliable, like the Gunn oscillator/waveguide attenuator and coaxial transition used for 10 GHz test configurations. Keep it simple: high accuracy generators are nice but not necessary. See **Fig. 1 and Photo B** for my 10 GHz generator.

Next, to improve your calibration and test agility pick up some coaxial attenuators of various values of dB loss. These will be necessary to use in conjunction with your power meter to prevent burnout of the sensitive power meter head. These heads will usually

accept a maximum of +10 dB. Power levels above this can burn them out and they're not repairable. Remember here that 100 mW (.1 watt) is +20 dB and this level is easily reached in most circuits. Use a 10 to 20 dB protection pad on the input of your power meter for the safety of your power meter head.

A new twist on the test equipment angle is that very modern circuitry is making high-tech test equipment obsolete. Well, this is true to some extent in that recent advances in frequency control and receiver and transceiver circuitry are starting to make these products look more like computers than the products they really are. An example of this is the vertical hold control on your television receiver. Early sets had both vertical and horizontal controls accessible for your adjustment. Try to find one today; they use zero crossing detectors, instead of the earlier consumer controls, to lock up the picture. So it is with microwave circuitry in some cases.

Yes, you still need a generator to provide a test signal to tune stripline circuitry. The microwave power meter is required to give you "eyes" on power changes on tune-up or modification. Attenuators are required to limit power to acceptable levels for protecting the instrument. Frequency measurement and accuracy to your desired limits provide an additional window to give you a comfort zone in test equipment adjustment and modification ease.

With some of the newer frequency-controlled synthesizers in use today to generate a local oscillator for microwave down converting, high accuracy microwave counters are needed for reassurance of actual frequency. In most cases using these modern synthesizer components, once phase-lock is obtained you are there. Specifics: Our group uses a surplus synthesizer that uses a Qualcomm 3036 phase-locked loop chip that functions directly at 1.6 GHz (**Photo C**). All frequency generation is by VCO in the 2 to 3 GHz range. This chip (3036) can be set up to be programmed from an IBM bus or for pin-for-pin programming of frequency (**Fig.2**).

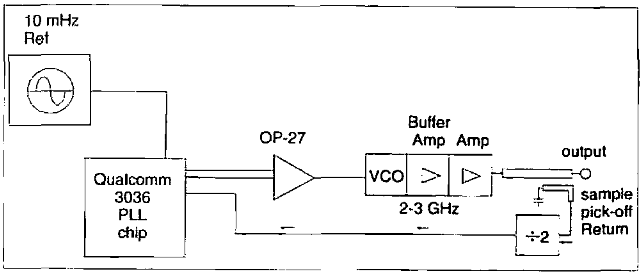

Fig. 2. Block diagram of a Qualcomm 3036 oscillator. This unit can be reprogrammed to 2556 MHz for 10 GHz operation, 2304 MHz for beacon work, or even 2160 MHz for .3 GHz operation. It's quite a versatile PLL controlled VCO.

Now, with this synthesizer you could program 2556 MHz times four to provide LO injection at 10 GHz. Frequency combinations are endless. For example, 2160 at LO for 2304 with an IF frequency of 144 MHz. 2304 could be programmed for a test source or even a beacon on that frequency. If you program 2304 there is an on-board frequency divider (I said earlier that the 3036 only worked to 1.6 GHz, remember?). Dividing that by two, it could be used to pick off 1152 MHz. This one frequency and its harmonics are the mainsail of all microwave generators.

If you multiply 1152 times 2, 3, 5 and 9 you get the standard microwave frequencies of x 2 = 2304, x 3 = 3456, x 5 = 5760 and x 9 = 10368 MHz. This is nice frequency multiplication for simple generator circuits. Just overdrive an MMIC amplifier to accent the harmonics and use the signals for your version of the Gunn oscillator, not only at 10 GHz but on all the other ham bands below 10 GHz except 1296 MHz. Well, that can be handled also. If you mix in 144 MHz it will produce 1296 MHz as one of its products.

How stable is this synthesizer? If the wobble in your main frequency cog is limited to a 10 MHz TCXO oscillator, that is capable of maintaining .01 to .1 hertz at 10 MHz. In actual use this wobble works out to be less than SSB bandwidth errors at 10 GHz (a few hundred hertz maximum error).

Conclusions

What specific test equipment would I recommend? Well, I would like each of you to have a complete lab, but knowing this is not always possible I would suggest a group pool of test equipment. With several interested amateurs each contributing, you just might start a microwave interest group of your own. Check out the Startek ATH-50, or the Digimax or Optoelectronics frequency counters. They will allow you to operate to over 2 GHz with sufficient accuracy extrapolated out to 10 GHz. Remember: It's not extreme accuracy that is required if your signals can be found inside the SSB or FM bandwidth required for normal operation. Then it's just: Readjust the RIT control for clarity. Exact sometimes gets boring.

From the junk box side of things, I have picked up some surplus items you might be interested in. I have a quantity of 15 mW Class III HeNe laser heads manufactured by Melles Griot. They require a power supply and measure 7 to 8 mW output with my test arrangement. Also, I have picked up several LORAN-C complete PC board receivers. The lasers are $45 postpaid, and the LORAN-C receivers are $15 each or two for $25 postpaid. At these prices for Loran-C they're untested pulls. I have tested 10 units and had only one not function fully. I do have a batch of units for parts, great 100 kHz circuitry and coils. If you want one with your order let me know and I will throw it in for postage costs.

As always, I will be glad to answer questions pertaining to this and other amateur related topics. Please send an SASE or drop me a line on the Internet. My address on the Internet is clhough@aol.com. 73 Chuck WB6IGP.

NEVER SAY DIE

Continued from page 47

upwards, and all those magnificent profits which had been supporting a Parkinson's Law of ever-increasing corporate body count disappeared. They probably could get rid of half of the staff and be able to respond to the market better. They also might not get stuck with turkeys like Scully's Newton.

I'm up to here in Macs, which are the most practical computers for publishing. So, like Spitzer, I'd like to see a spotlight on Macs for packet and other ham applications. It might even be worth publishing a column. How about it? I'd like to hear from a Mac expert interested in helping out.

Ham jailed

We really need to push the ARRL to get the FCC to change our rules so it is easier to delicense the rotten apples that get through the simple screening process. A case in point is the recent jailing of Ronald Ames WB6RSD, who has been a royal pain in the ass to his fellow hams for several years. Heck, the legal actions have been going on for over two years. The judge found Ames to be "arrogant, stubborn, and closed-minded." He put Ames in the slammer for 15 days and fined him $3,000.

There should be some way for us to drain our ham sewers, like that bunch of idiots on 14,313. We should have a way to get rid of frequency coordinators who favor friends, jammers, and so on. Old-timers will remember Max W2BIB, who devoted much of his hamming time to jamming emergency traffic. He finally died. And then there was W2OY, who did little to make hamming fun.

Fame

A Silent Key announcement from Australia for Syd Molen VK2SG reminded me of a recent editorial in which I pleaded with you to make us all aware of hams who have been doing good works. Syd, it turns out, was one heck of an RTTY pioneer—and I never heard of him before! As the publisher, starting in 1951, of an RTTY magazine, I knew all of the American RTTY pioneers...John Williams W2BFD, Merrill Swan W6AEE, Bob

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HAMSATS

Amateur Radio Via Satellites

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If you can't hear them, you can't work them. This simple premise is common to all facets of two-way radio. For the amateur satellite enthusiast, weak-signal operation is the norm. Satellites have limited power budgets. With the exceptions of the high elliptical-orbit satellites like AMSAT-OSCAR-10 and AMSAT-OSCAR-13, hamsats transmit less than 10 watts to very simple antennas. On the ground, good antennas, sensitive receive gear, and quality cable to connect them are required.

On the transmit side, the same rules apply. A poor antenna with inadequate feedline will require more power from the transmitter to get a signal up to the satellite. More power means more money for an amplifier.

Most hams shop for antennas with high gain, receivers with good sensitivity and transmitter systems with adequate power for the earth-to-space link for their satellite stations. Many hams will try to save money on the feedline. If the cable is not correct for the job, the receive and transmit signals are low, enthusiasm fades, and another satellite station goes silent.

The rig-to-antenna connection

If money were not a concern, multiple runs of 7/8-inch diameter Andrew Corporation Heliax would do well for all of the current satellite bands from HF through SHF. Five 100-foot runs with new cable and connectors would cost about $750 per run for a total of $3,750. Surplus or used cable and connectors would cost a lot less, but other considerations take over. A bundle of cables that large would be hard to position and almost impossible to connect to rotatable antennas. Jumpers and additional connectors would be needed. Some interesting explanations might also be in order if the radios were in homes and holes had to be drilled for the large feedlines.

Putting together a quality, yet cost-effective, feedline configuration requires some careful study and a few trade-offs. While the Heliax would be great for a long run at 1.2 GHz, it would be serious overkill at 21 or 29 MHz.

With little previous knowledge of coaxial cables and connectors, most newcomers to the predominantly VHF and UHF realm of the amateur radio satellites find the options daunting. One look at a Belden catalog of wire and cable or an Amphenol RF and microwave connector listing can lead to quick confusion. For most antenna installations using frequencies from 450 MHz and down, a few simple guidelines can help.

Coax

For short coax runs (less than 50 feet), a premium-grade, brand name, 50-ohm RG-8/U type coax will do the job. The "RG" is a military designation for coaxial cable and the "U" means "general utility". For outdoor use, RG-213/U (Belden part number 8267) is an excellent choice. It has reasonable loss characteristics, 97 percent shield coverage and a non-contaminating PVC (polyvinyl chloride) jacket that will survive exposure to the sun and weather much longer than others.

Loss characteristics are usually given in dB (decibels) per 100 feet for various frequencies that may be used through the cable. The Belden type 8267 exhibits a loss of 1.9 dB per 100 feet at 100 MHz, 4.1 dB at 400 MHz and 8.0 dB at 1 GHz. This means that with a transmitter running 100 watts on 100 MHz at one end of the 100-foot cable, the 1.9 dB loss would attenuate 35 percent of the signal, or 35 watts. Only 65 watts would make it out the other end. The rest would be absorbed in the cable. At 400 MHz, the same 100 feet of cable would lose 61 percent of the signal, and at 1 GHz the cable would lose 84 percent of the signal. At the end of the cable, only 16 watts of the original 100 watts would be available.

The insulation between the center conductor and the outer shield is solid polyethylene for the Belden type 8267. The nominal velocity factor due to the use of solid polyethylene as a dielectric is 0.66. This value is the transmission speed of RF energy in a length of cable compared to speed in free space. It is usually expressed as a percentage.

Belden RG-8-AU (P/N 9251) has almost identical specifications, while the RG-8/U (P/N 8237) uses a slightly different inner insulation and does not have the non-contaminating jacket. Outside use will therefore limit the useful lifetime of the RG-8/U. Another favorite due to favorable loss characteristics and reasonable cost is the Belden 8214 coax. It is an RG-8/U *type* cable. It has the standard PVC jacket, but with a cellular polyethylene inner insulator that increases the velocity factor to 0.78. It is sometimes called RG-8 "foam" coax. The cable has slightly better loss characteristics than the other RG-8 cables, but it is not meant for installations with continuous exposure to moisture.

A favorite coax for longer runs, up to 100 feet, is the Belden 9913 coax cable. Although it has a standard PVC jacket and cannot make tight turns, it does have lower loss at VHF and UHF frequencies than the RG-8 types. The 9913 coax has a 100 percent shield using a braid-covered foil. The inner insulation is semi-solid polyethylene and the center conductor is solid (size 10) bare copper. The air/polyethylene dielectric provides a velocity factor of 0.84. At 100 MHz it has 1.3 dB of loss per 100 feet, 2.7 dB at 400 MHz and 4.5 dB at 1 GHz. It can usually be purchased for less than $0.45 per foot in quantity.

Some recent variations of the Belden 9913 are also available, but at higher prices. The Wireman (phone 1-800-727-9473) sells Flexi-4L which has very similar loss characteristics to 9913, but uses a stranded center conductor for a better bending radius, and can be ordered with different jacket types for inside or outside use. The cost per foot is about $0.60. SSB Electronics (phone 1-717-868-5643) sells a popular European 9913-type cable called AIRCOM PLUS. The cable is very stiff due to the solid center conductor, costs $0.77 per foot in 328-foot rolls, but is advertised with loss characteristics that are even better than 9913 by a few tenths of a dB per 100 foot at most frequencies.

For the satellite frequencies in the HF spectrum (21 and 29 MHz) coax runs are not nearly as critical. For most applications, RG-8/U will be an excellent choice. The smaller-diameter RG-8/X (Belden P/N 9258) can also be used, although it has a standard PVC jacket and cellular polyethylene inner insulation. For short runs, RG-58A/U (inside) or RG-58C/U (outside) will do well. At 29 MHz, RG-58A/U has almost 3 dB of loss for 100 feet of cable, RG-8/X has about 2 dB, and RG-8/U has about 1 dB.

For satellite frequencies above 1 GHz, the cable can become a major financial problem. The 7/8-inch Heliax has an advertised attenuation of 1.31 dB per 100 feet at 1 GHz. This is still a 25 percent power loss, but it's much better than the 64 percent loss with 9913 or the incredible 99.3 percent loss with RG-58A/U. Lengths of RG-58A/U are sometimes used as intentional attenuators at UHF and SHF frequencies.

Connectors

As with cable, the primary rule with connectors is to stick with brand names. Most satellite hams have a good collection of Amphenol "UHF" and "N" connectors for their standard cable runs. A few other manufacturers of note include Kings and Trompeter. Avoid the no-name clones. Many look fine, but act as attenuators at higher frequencies due to tolerance problems and lossy dielectric material.

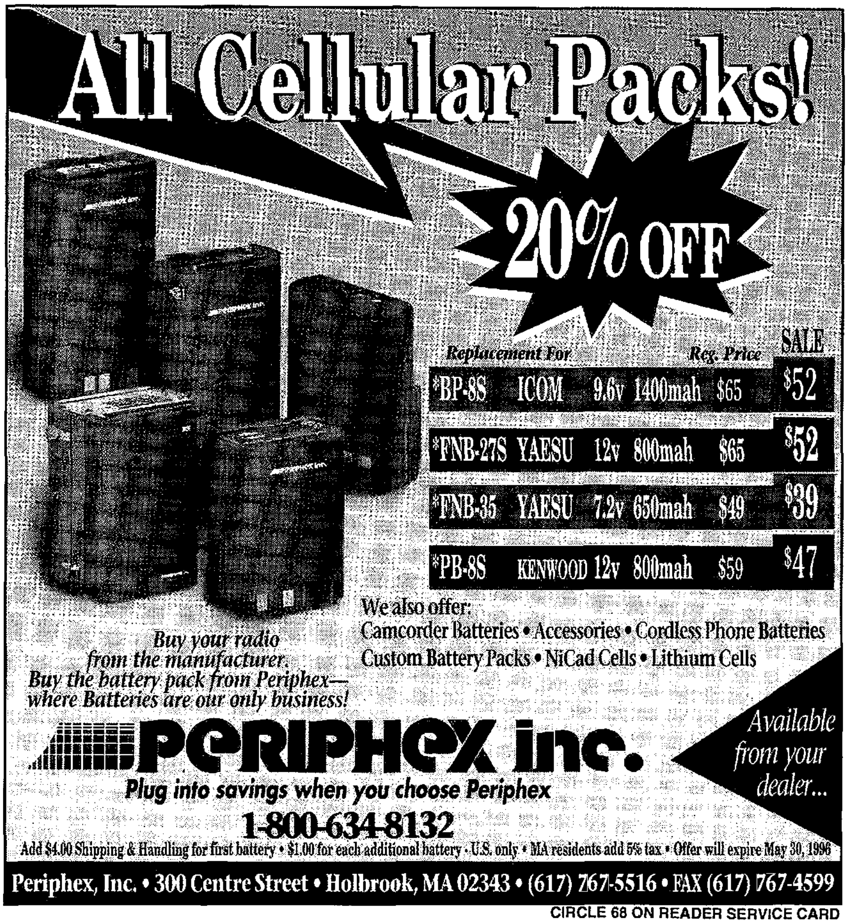
The so-called "UHF" connectors (SO-239 and PL-259) should be avoided above 148 MHz. Some purists have said that these connectors are great for CB and audio, but worthless elsewhere. Amphenol states that these general-purpose RF connectors are designed to operate

"satisfactorily" up to 300 MHz. If used properly, they will do fine for the satellite bands below 420 MHz, but even then, the Teflon™ insulation type should be used.

Above 420 MHz, "N" connectors are appropriate. They have a much higher voltage rating than UHF connectors and are typically rated for use up through 11 GHz. Due to a larger center conductor on 9913 coax, special "N" connectors are required. They usually have the same outer shell as those for RG-8 type coax, but have a special center pin to take the larger diameter center wire.

Some imported "N" connector clones have exhibited incredible losses at frequencies above 1 GHz. In high-power 1.2 GHz amplifiers, they may even get hot, assuming that other mismatch problems don't arise.

When installing connectors to coax, either follow the instructions that come with the connectors or check the *ARRL Handbook*. For outdoor connections seal the connector with non-corrosive RTV sealant and tape or thick-walled heat shrink tubing. The rig-to-antenna connection is the key to success for any satellite earth-station installation. 73



CIRCLE 68 ON READER SERVICE CARD

HAM TO HAM

Your Input Welcome Here

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Spring is rapidly approaching—it would be nice to see more ideas and suggestions for spring and summer projects. What have you found that might benefit the rest of us? As always, any general ham-related ideas are welcome...here are a couple of my own.

A "customized" connector

I recently needed a 7-pin male DIN connector to plug into the accessory socket on my Kenwood TS-430S in a hurry — they're not the easiest of connectors to locate! So instead I bought an 8-pin DIN plug from Radio Shack™ (their #274-026) and was able to cut down the center 8th pin far enough (using a pair of small diagonal side-cutters) so that it fit nicely into the 7-pin socket on my transceiver. The spacing of the 7 remaining pins is the same as that of a true 7-pin DIN plug.

First aid for crumbling insulating tape

Some hand-held VHF/UHF transceivers come from the manufacturer with plastic tape laid across solder connections that might touch other conductive surfaces when the small circuit boards are finally "layered" together. After time, the tape and its adhesive dry out, literally turning to dust. I've found a suitable replacement tape, one that won't leave much residue when lifted up, as near as your local drug store.

The type that I've been most happy with is made by Johnson & Johnson; it's their 1/2-inch wide waterproof First Aid tape. It's a cloth based tape, with serrated edges, and has an effective, yet non-gumming adhesive backing. Of course it's intended to be used to secure a bandage, but it also makes a good general purpose insulating tape for use with low-voltage electronics. Since it's formulated to be waterproof, it doesn't seem too hydroscopic (prone to pick up moisture from the atmosphere), making it suitable for use in radios that will spend most of their lives in a mobile or marine environment.

Don't blow money on blown fuses!

From Herb Foster AD4UA: Here's an easy way to test a piece of equipment that continually blows the AC line fuse, without having to keep feeding it expensive little fuses.

Make up a trouble lamp with well-insulated clip leads on the ends of the AC cord, instead of the normal 2-prong AC plug. Install a 60 to 100 watt standard 120 volt lamp into the socket. Leave the fuse-holder in which the fuse keeps blowing empty, and clip the trouble lamp across it. When you apply power to the piece of equipment, the lamp will shine at near full brightness if the short in the circuit is close to zero ohms, or a bit less if it's not right at zero ohms, but still fairly brightly. Once you've cleared the short by lifting components or opening circuits, the trouble lamp across the fuse holder will glow very dimly when power is again applied, depending upon the amount of "normal" current that the device is actually drawing from the AC line.

Now you can disconnect the trouble lamp and reinstall a good fuse, knowing that the fuse will more than likely "hold" this time around.

Herb's suggestion works because a "cold" 120 volt lamp has very low resistance, and will therefore allow enough current into the troublesome circuitry if the short has been cleared, but not enough to cause harm if the short still exists, since its "hot resistance" is acting to limit the maximum current. A 60 watt, 120 volt bulb will be 15 to 16 ohms cold, a 100 watt 120 volt bulb about 9 or 10 ohms cold. It's a good way to dynamically test a piece of equipment without causing further harm. Just make sure that everything is well insulated—as Herb mentioned—and that you stay clear of the 120 volt circuitry any time the device is plugged in.

Pushing the (peak) envelope

From Ken Guge K9KPM: In the "old days," an amateur could determine his or her legal transmitter power by multiplying the anode voltage of the final amplifying stage times its current (the DC power input to the final transmitter stage), and as long as that figure was kept under the maximum allowable, that was all that the FCC expected the individual to know. It's not quite that easy today.

The FCC now expects an amateur to keep PEP (Peak Envelope Power) output under a certain maximum, depending upon the power restrictions of the license class and within the band that's being used. It's 1500 watts PEP for most operators on most of the bands, but that maximum is only 200 watts for everyone in Novice 80, 40 and 15 meter sub-bands and for Novice class licensees within the 10 meter band. Novices are permitted only 25 watts PEP on the 1-1/4 meter band and 5 watts PEP at 1270 MHz. All classes of licensees are restricted to 200 watts PEP throughout the 30 meter WARC band. It's 100 watts PEP for all beacon stations and 50 watts PEP within the 70 CM band in certain geographical regions. Refer to a current copy of the FCC rules for the specifics on any of these figures.

The point is that we can't just say "I'm running well under 1500 watts PEP so I'm safe." You're expected to know that you're within the legal limit, based upon your class of license and band of operation, and here's the way to do it.

PEP, or Peak Envelope Power, is the average RF power being fed into the antenna's transmission line (down at the shack), during one RF cycle, at the peak of the modulation envelope, with an SWR of 1:1 and under normal operating conditions. The most accurate way to measure PEP is with a monitor scope, coupled to your transmission line and terminated in the line's characteristic impedance (usually 50 ohms). The presentation on the scope face will be a peak voltage, so it's averaged by multiplying its value by .707. That answer is then squared and that result is divided by the 50 ohm transmission line impedance to get actual PEP power in watts. Sounds confusing, but here are some examples that might help clarify:

22 volts times .707 = 15.554 and 15.554 times 15.554 = 242 divided by 50 = 4.84 watts PEP

70 volts times .707 = 49.49 and 49.49 times 49.49 = 2,450 divided by 50 = 49 watts PEP

To calibrate your scope for 100 volts peak, put 100 watts into dummy load, with the scope in line, by adjusting the transceiver's CW key-down output while monitoring a wattmeter of known accuracy (some transceivers and dummy loads have an output wattmeter built right into them). 100 watts average into 50 ohms comes out to 100 volts peak (an interesting coincidence of numbers). Ohm's Law tells us that voltage is equal to the square root of the wattage times the resistance. 100 average watts of power times 50 ohms equals 5000, and the square root of 5000 is 70.7 (average voltage). 70.7 times 1.414 (1.414 is the multiplication factor that's always used to convert average to peak) = 100 volts peak voltage. Take a second to look it over again, don't get average and peak confused nor power and voltage mixed up. Also remember that "normal" wattmeters read average wattage, and the FCC wants us to know our PEP power output. Scopes will read peak voltage, and once the scope is calibrated correctly, you can use the examples above to determine the PEP wattage from the peak voltage that you've read on the scope.

Also notice that the relationship between peak voltage measured on the scope and PEP power is a logarithmic, rather than a linear, one. When the voltage doubles, the power increases by a factor of 4 to 1. When the voltage goes up by a factor of 10 to 1, the power increases by a factor of 100 to 1.

There are also peak-reading wattmeters commercially available to us as hams, but using a scope is the most accurate way of determining PEP power, and it's the only way to check the accuracy of a PEP meter. It's a good idea to be aware of (and practice) the scope method, just in case the legality of your PEP power output is ever questioned by the Commission.

Stealth chimney

From Bill Thim, Jr. N1QVQ: A different approach to a stealth chimney-mounted HF long wire antenna. Here's a suggestion for hams or SWLs living in a condo or other development that prohibits the installation of visible outdoor antennas of any type. Wanting to have a long-wire antenna that was totally invisible, and having a chimney made of brick and mortar, I started out at the bottom of the chimney, where a good ground is available, and laid #22 wire into the mortar joints between the bricks. I used a zigzag pattern as large as the chimney width permitted, then applied another "cover-up" layer of mortar on top of that. Upon reaching the chimney top, I dropped the wire through an unused flue pipe into the house. The average two-story chimney can accommodate 250 to 500 feet of wire — depending upon the width of the zigzags — by using this technique, and it's completely invisible except for a few inches at the base and a few inches at the very top. I was able to end up with nearly 500 feet of wire, which, via an antenna tuner, allowed me to copy all of the HF bands from 160 to 20 meters with surprisingly good results.

Bill also mentioned, that in his case, he had to get management's approval for the "tuck-pointing" work, but in areas where single family detached homes are the norm, that probably wouldn't even be needed. Bill hasn't used his stealth antenna for transmitting, but it should be usable on at least some of the HF bands, with the proper tuner in line and at reduced power levels. As he also pointed out, it's certainly better than no antenna! I wonder what the radiation pattern would look like on 20 meters?

Paint it silver

From Richard Measures AG6K: A cure for intermittent connectors in today's radios. The subminiature push-on, crimped-on coaxial connectors, used in many ham transceivers to interconnect RF or IF signals between circuit boards, can become intermittent or exhibit higher than near-zero ohms resistance on occasion. A poor connection at the center pin of these connectors can result in numerous intermittent output problems, in the case of a transmitter section, or varying sensitivity problems if the offending connector is in the receiver's circuitry. The crimp-on pins in these connectors have a tin plating, which, when crimped against the copper inner conductor of the subminiature coax, can create a dissimilar-metal electrolytic action that eventually turns the crimp connection into a semi-insulator.

Deftly soldering the tiny ends of these connectors, without damaging the coax cable inside, can be more difficult than some may want to risk, so another solution may apply if you're in that category. GC Electronics, among others, makes a conductive paint (Silver Print® is GC's brand name) that can be successfully used in these cases. It's normally sold through electronics component dealers, locally or via mail order. The silver conductive paint can be applied to the tip of the tiny coax connector with a straightened paper clip, coating the tip junction of the protruding wire and the connector pin surface to restore good contact.

The same scheme will also work for intermittent or high–resistance crimps on the small multi-pin control-cable connectors used in most modern rigs. The suspect female pin on one of these small connectors can usually be removed by carefully removing the connector, then depressing the tiny locking tab — accessible through the rectangular hole over each pin — with a scribe or small jeweler's screwdriver, and carefully slipping the pin back out of the connector body itself toward the wire's entrance. Don't pull too hard, or you may break the wire off completely. If the locking tab is depressed enough, you should be able to extricate the pin. Again, a dab of some conductive silver paint can be applied to the crimp connection with a straightened paper clip and allowed to dry before replacing the pin back in the connector. Don't forget to bend up the little locking tab again before reinserting the pin. You should hear or feel a tiny "click" as the tab engages.

Unless a crimped connection is so tight air is unable to reach the two conductive crimped surfaces, the electrolytic action that Rich speaks of is virtually inevitable, especially in areas of high humidity situations such as might be found in a mobile installation. There are well-applied crimped connections (partly dependent upon the design of the connector itself), but not every one can be assumed to be of that type.

Rich is a well-known author of numerous tips and equipment modification suggestions, perhaps most noted for his diligent work on HF amplifier parasitic suppression problems. Rich has delved into a number of modern transceivers and ferreted out the problem areas in those radios. Watch for other contributions from AG6K in the coming months. Thanks, Rich.

Keep the engine running!

From Peter Albright AA2AD: Another of his handy tips for quickly testing transistors in-circuit. The first "quick tip" that appeared in this column dealt with testing transistors statically and out-of-circuit, but it would be handy to do some preliminary testing without removing every transistor from the board! Here are some tips for locating defective transistors while they are still mounted on the board. The tests are run with the case opened and power applied, so please BE CAREFUL. In addition to the danger to yourself, troubleshooting a piece of equipment can be complicated by one slip of the test probe; you don't want to create additional circuit problems!

Good technicians always begin the troubleshooting process with careful observation. Is a transistor too hot to touch? Remember to keep one hand in your pocket when you stick the other into the equipment's guts, and keep both hands away from high-power RF circuits! Transistors can become quite warm, even in normal operation, but generally not hot enough to raise a blister. Conversely, if a transistor looks like it is designed to dissipate heat (a big case mounted on a hefty heat sink is a good clue), but it's cold to the touch even after several minutes of operation, it may not be conducting. Watch for those clues. Is there a resistor that's discolored from excessive heat? Has any component become so hot that the board is discolored? It may be normal, or it may be another clue.

After careful visual inspection, it's probably time to break out your trusty voltmeter. By the way, a digital voltmeter is generally better for these tests because of the often small relative differences involved. You'll see what I mean.

Transistors that are conducting normally show predictable voltage patterns. Specifically, the voltage drop between the emitter and base of a silicon transistor should be between 0.6 volts and 0.7 volts (about 0.3 volts for a germanium transistor). The voltage at the base should fall somewhere in between the voltage at the emitter and the voltage at the collector. For an NPN transistor, the collector will be more positive than the emitter. For a PNP transistor, the collector will be more negative than the emitter. While the voltage difference between the emitter and the base is 0.6 to 0.7 volts, the difference between the base and the collector is generally much greater. Remember that these values are relative to each other. Here's a chart of six imaginary transistors, showing logically possible voltages for each, relative to ground, that you're likely to find on a good transistor—one that's conducting normally. Note that these patterns do not apply to a good transistor acting as a switch in the "off" mode. Also, transistors acting as higher power RF amplifiers may check somewhat differently, but the chart does give you a good idea of the viability for the bulk

of the other transistors you're likely to find on a board.

NPN
e+2.0 e-2.0 e-.05
b+2.7 b-11.3 b+.02
c+12.0 c-3.8 c+48.0

PNP
e+12.0 e-3.8 e+48.0
b+11.3 b-4.5 b+47.3
c+2.0 c-12.0 c-0.5

Remember, the chart shows typical voltages measured with respect to ground, so don't expect them to be exact in any particular circuit that you might be troubleshooting. Again, what we're looking for here are indications of parameters that are grossly wrong.

Often it's easier to simply measure the voltages across the legs of the transistor, as opposed to measuring one junction to ground. If you can identify the emitter, and put one voltmeter probe on that lead, you will measure about 0.6 volts to the base with the other voltmeter lead; the meter will measure a greater differential to the collector. The polarity of the voltage will tell you whether the transistor is NPN or PNP; you can often identify the lead configuration of a good transistor by the voltage differences on these three junctions. Again, we're looking for relative differences across the device itself.

Although some physical lead configurations are more common than others, you can never assume that the lead configuration on two transistors is the same, just because they happen to look alike. The transistor manufacturers have done that just to keep us on our toes!

Peter offers some good practical advice in his treatment. As before, it's probably worthwhile cutting this information out and keeping it handy, for the next time you're faced with an involved troubleshooting job. A small plastic card file, with tips like these on the cards, will save you additional time and frustration trying to remember when and where you saw the information you need.

Scrub 'em, don't scrap 'em

From Klaus Wolter N8NXF: A method of soldering to aluminum without the need for special solder or equipment. Here's a technique that I've used several times with success:

1.) Carefully scrape the area to be soldered so that it's good and clean, and so that fresh, raw aluminum is exposed.

2.) Aluminum carries away heat very rapidly, so you must use an iron that's hot enough to keep a ball of solder molten once it's in direct contact with the aluminum.

3.) Firmly and consistently "scrub" the area on the aluminum to be soldered, then slowly apply regular 60/40 rosin core solder, trying to "rub it into" the aluminum with either a back-and-forth or a circular motion.

4.) If all goes well, you'll begin to notice that some of the solder ball is sticking to the aluminum; keep working the area until you've created the pad size that you want.

You should now be able to attach wires or component leads to this pad of solder. It's not easy, and it does require persistence and a bit of skill, but it can be done. Practicing on the inside of an empty aluminum beverage can will hone your skills in the procedure before trying it on a finished project.

Klaus' idea does work on certain types of aluminum; I've used it myself in the past. It may not work on all varieties of chassis material, since what we call "aluminum" can take on many variations in actual formulation percentages of other metals. I've also successfully used a soldering flux containing Zinc Fluoroborate, and Mono- and Di- Ethanolamine for soldering to some aluminums and stainless steels. One such product is manufactured by Henry Mfg., P.O. Box 155, Westville IL 61883. Long ago I heard that the "big secret" to soldering to aluminum is to not give the raw aluminum surface a chance to oxidize, which it does immediately upon contact with the air, and that seems to be why Klaus' technique works when used with the persistence he mentioned. Be cautioned that a copper-to-aluminum solder joint may not have the strength of a copper-to-copper solder joint, and its conductivity may alter over time. Good long-term conductivity in any solder joint requires that there be an alloy bond between the metals involved—this may not always be the case between tin/lead solder and some aluminum formulations.

At the end of your rope?

From Robert Blacka N2WSO: A tip that bears remembering when you're shopping for new rope for that upcoming spring antenna project. I was browsing through my local Home Depot™ home improvement center when I came across a variety of rope that yelled out "amateur radio!" Needless to say, I bought a couple packs! The product is called "Camouflage Poly Rope," and it's made by The Lehigh Group of Allentown PA.

It's reasonably priced, one quarter inch in diameter, rated at 113 pounds working load and virtually invisible against a background of trees or other vegetation. Perfect for ham antenna work! Side-by-side comparisons between the camouflage rope and standard white nylon antenna support line of an even smaller diameter confirmed the night-and-day difference in visibility. Even if the background isn't vegetation, the camouflage rope is tough to see in comparison with other solid-colored rope, because the human brain easily interprets straight lines of one color, but not of broken or random colors. The military discovered this decades ago and even Mother Nature herself has equipped many animals with a similar color scheme.

I've had several sections of Lehigh's "Camouflage" 1/4-inch rope out in the weather for over a year now, with no signs of deterioration. It appears to be conservatively rated by its manufacturer. It also appears to be a seasonal item, so ask about it if you don't see it stocked. It would probably find more widespread use among hams if it were available for sale at hamfests—now there's another idea for all of you weekend entrepreneurs!

And that concludes another month of Ham To Ham. Thanks to all who sent in their suggestions, tips, ideas and shortcuts...how about you? We've all discovered "better" ways of doing the average, everyday things we face in the pursuit of our hobby. How about sitting down for a few minutes, jotting down your ideas and sending them to the address at the masthead? I'll acknowledge all contributions and give you an idea as to if and when the tip will be used in the column. If it is used, Uncle Wayne's elves will send you ten bucks for your time and postage expenses. What a deal! I'll be back next month with many more worthwhile ideas.

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Please send all correspondence relating to this column to *73 Amateur Radio Today's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

NEVER SAY DIE

Continued from page 61

Weitbrecht W6NRM...but no one from Australia has ever bothered to let me know about what Syd was doing.

Come *on*, if a ham mover and shaker you know won't blow his own horn, it's up to you to pick up the slack. As Gilbert put it, "If you wish in the world to advance, your merits you're bound to enhance. You must stir it and stump it, and blow your own trumpet, or trust me you haven't a chance." Okay, what musical was that from?

The VK2SG obit mentioned that Syd, who died at 76, had been having health problems for the last six years of his life. To me that says that I need to do more to get the word out that health problems, almost without exception, stem from diet. If you put a little sugar in your car's gas tank every day you can easily cut your car's life in half. I'm not selling any fad diets or vitamins (yet, anyway), just asking you to read the books I've found that make the most sense when it comes to the maintenance of your body.

It makes sense to me to provide our bodies with the same raw materials our ancestors ate, drank, and breathed over the millions of years of our development. A Danish, coffee and Tang breakfast doesn't make any kind of sense. Nor does a burger, fries and milkshake lunch. Sure tastes good though. And drugs can make you feel good. For a while.

Another new technology

Secure Technologies Inc. of Lexington, MA, has come up with a neat little radio gadget. It's a range-finding unit which will help anyone keep track of where people or animals are. It requires a base unit and a small portable device which can be used to keep track of dogs, kids (at a mall, say), Alzheimer's patients, cattle or sheep herds, and even prisoners.

It uses a 900 MHz band transmitter n the base unit which sends out a 1 ms pulse of RF, modulated at 500 kHz. The portable unit receives this and retransmits it back on a different frequency (like a miniature repeater). The base unit measures the phase shift between the two signals and translates that into distance. The base signal also contains an identifying code so many of these units can be used in the same area without interfering with each other. If the distance exceeds an adjustable programmed number, the base unit will sound an alert.

This seems like a great way to cut the cost of prisons, with the authorities able to know whenever a prisoner goes beyond a given limit. It's a different and much lower-cost type of prison cell. With the base unit easily portable, it's easy to use it to find a person or animal that has gone beyond the limit set.

This is a clever use of electronics, but is it anything that you couldn't have developed, if you'd thought of it? If it is, then you haven't been learning your fundamentals, just memorizing your way to your ham ticket. Amateur radio is not only a way to have a whole lot of fun and adventures, it's also a license to learn and build your technical skills.

And for that matter, how come *you* didn't think of it? My excuse is laziness; what's yours? I'm too busy having a good time to sit down and think creative thoughts.

STI has come up with a great new product. That means they're probably going to be looking for investors to bring it to the market. They're going to need some hot sales people, advertising and promotion experts, and so on. They'll need engineers and technicians to help design, build, test, sell and service the stuff.

Cold fusion news

Big news! The US Patent Office has, for the first time, issued a patent on a device claiming to generate excess heat (2000%). Dr. Patterson had got a couple of patents on his cold fusion cells in which his supporting figures showed excess heat being generated, but he hadn't claimed that before. Now, in patent # 5,494,559, issued Feb. 27th, they've accepted his claim. Not

Continued on page 71

QRP

Number 62 on your Feedback card

Low Power Operation

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I admit I go through a lot more rolls of solder than logbooks. I enjoy the challenge of building new circuits. However, troubleshooting them can be an exercise in logic as well.

So it was when a friend of mine contacted me to take a look at the QRP transceiver he'd built, the QRP-15 CW transceiver by Rick Littlefield K1BQT.

Rick describes a small CW-only rig for the 15 meter band. This version, for 15 meters, is loosely based on his article, "An NE602 Based QRP Transceiver for 20 Meters." This article was published in *Ham Radio,* January 1989. Sorry, but I don't have access to either of the references mentioned. Check your local club's library for back issues.

In a nutshell, the rig is based on several NE602 mixer ICs. An analog VFO complete with an RIT circuit controls the frequency of the rig. The VFO operates from 5.000 MHz to 5.150 MHz. The RIT has a tuning range of about ±1.4 kHz. With the operating range set at 5 MHz, the IF dictated using a 16 MHz center frequency. While this may seem to be off the wall, in real life crystals for the filters and BFO are easy to obtain. They're commonly used in computers and other digital equipment. Both Digi-Key and Mouser electronics carry these crystals. They're cheap, too; about two bucks each.

Other than the 16 MHz IF, the rest of the rig is quite basic. However, in my friend's case, his version would not work.

First things first

Troubleshooting a home-brew project you put together yourself is one thing. Working on something someone clear across the country built is entirely different. So, the first step is to check for the usual cold solder joints and solder bridges. Finding none, we move up to the components and double-check for proper placement of all polarity-sensitive components, such as diodes and electrolytic capacitors. A quick check for the correct placement of all ICs is next in order. Also, and this may seems rather simple, but do check to see if each IC is in the proper location!

The simplest thing to do is take voltage checks of a kaput rig. A novice troubleshooter always asks, "Check what voltage where?" To begin, the best place to start is at the power supply jack, then work your way backwards. A 1N4002 diode installed backwards can keep the rig from working. Next, check for the proper voltage(s) at any of the three terminal voltage regulators. This includes their input and output pins. Take a quick look at the ground pin as well. The ground pin must read zero volts, not one or two volts. Unless the ground pin is held above ground by a resistor network, look for a cold solder joint or a cold solder joint someplace along the ground bus. In my case, the three terminal regulators were providing the necessary voltages.

Even if the required voltage(s) appears at the regulator(s), check each and every VCC pin on each and every IC. One cold or missing solder connection on the VCC pin will stop the rig dead in its tracks.

Here's a helpful timesaving tip for when you're checking for proper operation from a three terminal regulator. In the case of this 15 meter transceiver, there is one 7812 regulator supplying RIT circuit and the VFO/TX mixer. If you have your supply voltage (power supply, battery or whatever) set at 12 volts, the output of the 7812 will *not* be 12 volts. The three terminal regulators require several volts above their regulated output to operate correctly. If you like to operate by battery in the woods, then I would suggest replacing the 7812 regulators in all of your rigs with one of the low dropout units from National or Linear systems. Both companies make s :veral different voltage rating and current rating low dropout regulators. Some of these LVD regulators require only .3 volts above the regulator's output. For 12 volts at 1 amp, the LM2940T-12 is a perfect drop-in replacement for all of your TO-220 applications. For smaller current demands, the LM2950CZ-5 is available in the popular TO-92 case style. Both of these low dropout regulators are made by National Semiconductor.

The VFO—the heart of any rig

Now, I don't really care who said it, but finding the output of a VFO on a general coverage receiver is just plain nuts! You need a frequency counter. In this case, the VFO was running but at almost 8 MHz. The fix was taken in two parts.

First, the RIT coupling capacitor was removed from the VFO circuit. This eliminated any possible frequency shifting due to a messed-up RIT circuit. Fix the VFO first, then worry about the RIT.

Looking over the VFO parts, nothing seemed to be out of place. So, since the VFO was running too fast, making the output higher than needed, then one or more of the frequency-determining components was out in left field. Because the VFO *was* working, we knew the basic oscillator was running, so it was now just a matter of putting the output in its place!

Rick uses one NE602 as both the mixer and the VFO oscillator. It's a classic circuit and has been around since the NE602 first gained popularity. With plus 6 volts on the VCC pin, the output may be taken from either pin 4 or 5. With the RIT removed from the circuit, the only two parts that will determine the output frequency are coil L2 and the 50 pF variable capacitor.

To lower the frequency, we needed to add either capacitance or inductance. Had the VFO been running a tad too low, a simple and quick cheat would have been to remove one stator plate and check the output with the frequency counter. Removing stator plates is a whale of a lot easier than adding stator plates. However, we could add an external capacitor to pad down the tuning capacitor, leaving both stator and rotator plates untouched. While in theory this does work, it also reduces the amount of tuning range we could get. This is exactly what the calibration trimmer does to the circuit. It adds oh-so-slight an amount of capacitance across the tuned circuit, lowering the oscillator. In the case of our 15 meter rig, the calibration capacitor was rated at 8 pF.

The only sure-fire fix was to remove L2 and rewind it. Sure enough, there was not enough wire on the toroid; this easily increased the frequency of the VFO. To make matters even more interesting, the difference of one or two turns really shot the frequency up or down. After I had the windings in the right neighborhood, I applied some SuperGlue gel to hold the turns in place. That fixed the VFO and it operated in the frequency range it was designed for.

The output of the VFO goes to the TX mixer, another NE602. Between the VFO and the TX mixer, Rick uses an MPF102 to buffer the VFO's output. From the drain of the MPF102, RF is picked off via a 500 ohm trimmer. Although the trimmer is not critical to set, use caution so you do not apply too much RF to the mixer. All kinds of nasty things will crawl out of the NE602 if you overdrive this mixer.

The best way to set the TX mixer level is to monitor pin 1 of U6 with an oscilloscope. Adjust the mixer drive until the signal begins to flatten off. Now reduce the drive just a bit, so all you see is a clean sine wave going into the TX mixer.

Transmitter

Since this is the easiest part of the rig, let's follow the output from the TX mixer to the antenna.

By using your Tscope, you should see the input from the VFO on pin 1 of U6. IC U6 mixes the VFO signal with the signal provided by Y1. Again, as in the VFO, Rick used the NE602 as an oscillator. Check for operation of Y1 at pin 6 and 7 of U6. (I'm not able to reproduce the actual schematics.)

Output of the mixer, now at the frequency we want (in this case 21 MHz), should appear at the base of the driver transistor, a 2N5109. If not, then there's a solder bridge between pins 4 and 5, or L7 is wound incorrectly. Adjusting the TX/MX trimmer should produce a peak at the base of the driver.

Move forward to the final. RF, now rather heavy, should be on the base of the MRF475. Check for +12 volts on the collector of this transistor. If you read zero volts DC, then there is a wiring error in T1. If everything is working as it should, you'll see about 2 watts output to the antenna. *If everything is working.* And that's where we'll pick it up next month as we fix and improve the 15 meter transceiver. 73

Number 62 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

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Adjusting the epithet

We hams are famous for acronyms and abbreviations. Whether it's RTTY, AMTOR, QSL, or plain old CW, every letter has a meaning, no matter how obscure. In my warped mind, MFJ always stood for Mighty Fine Junk; after this month's batch of offerings from them, I may have to change that appellation.

Many readers will remember my tale of the bow and arrow placement of my antenna some years back. The version of the G5RV antenna I put up cost me about $50, and now, several years later, it has broken at the balun. Just the ticket to replace it is MFJ's version of this venerable antenna. This efficient 102-foot doublet runs all bands in the 80 through 10 meter range, with 160 as an option with a tuner and ground.

Fully assembled, the antenna features strain relief feed points, custom-made Fiberglas™ insulators, and heavy gauge wire that's capable of running the legal limit. All this, for a nickel under $30. **Photo A** shows you the whole picture. Wouldn't you like to have one in your backyard? I don't know about you, but as soon as our weather here in the East breaks — it's been winter for about three years, I think — I would love to have one of these to replace the aging skyhook out there now.

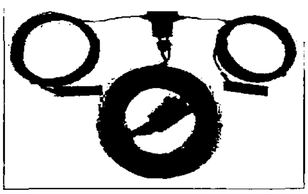

Photo A. All this, for a nickel under $30.

The little box in **Photo B** is the MFJ Multi-Reader, MFJ-462B, a $170 device that decodes a plethora of digital modes. Capable of decoding Morse, RTTY, and ASCII, this self-contained demodulator can either display incoming traffic on its built-in LCD display, or output them to a printer via an integral printer port. If you're into SWL or monitoring, this would be a simple way to go, to get dedicated digital reception at a reasonable price.

"If you're into SWL or monitoring, this is the way to get dedicated reception at a reasonable price."

On the other hand, if full-scale digital communication is more your style, have a look at the MFJ-1278B, their DSP multimode controller that does just about everything. With the sleek case, shown in **Photo C**, and with digital modes including RTTY, CW, packet, PACTOR, AMTOR, color SSTV, and gray level FAX, about the only thing this box doesn't do is fill in the logbook. There's a built-in 32k mailbox, expandable to 512k, a built-in parallel printer port, and, unlike another unit I've seen, this one comes with its own 110 volt power supply.

The c ontroller is available in several flavors, for several budgets, ranging from the basic MFJ-1278B for $300, without DSP, all the way up to the MFJ-1278B/DSP, featuring the "brick wall" DSP filters, for $380. MFJ's own software package, the MFJ-1289, is designed to take full advantage of the features of these controllers, and is sold separately. Again, here is another honey I'd love to replace an older unit with. Is anyone at my house reading my column?

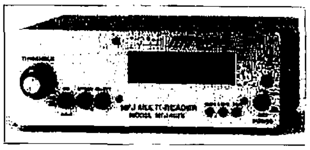

Photo B. The MFJ Multi-Reader, a little box that decodes a plethora of digital modes.

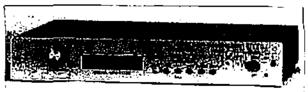

Photo C. About all the MFJ-1278B doesn't do is fill in the logbook.

Information on all of these products may be obtained from MFJ, at P.O. Box 494, Mississippi State, MS 39762, or call them at (601) 323-5869. Just be sure to tell them you read about it here, in RTTY Loop.

A few months ago, I mentioned the Snappy video digitizer, and invited those of you using the device to submit pictures of you or your projects. I received an E-mail from Bob KI5PG, who says he is a regular reader of the column. He purchased the Snappy video capture device, and is really having fun with it. Right now, he is using it to prepare illustrations for a short article on wiring the communications headsets sold for $5. I wonder if he will send the article to *73?* Anyway, **Photo D** is a picture of Bob, sent via the Internet.

Here are some interesting WWW links this month, passed along by Dave Horsfall, VK2KFU, in Sydney, Australia. He suggests: http://www.nsw.wicen.org.au/ the home page of the Wireless Institute Civil Emergency Network, in New South Wales. Sort of like the ARES/RACES, it contains information of interest to WICEN members and other emergency-related people, and has links to related sites.

Another of his hot hits is: http://sydney.dialix.oz.au/~wiansw/ the home page of the NSW Division of the Wireless Institute of Australia (WIA), their national amateur radio organization. You'll find information about the WIA, and links to other pages as well.

Of course, the RTTY Loop Home Page, at: http://www2.ari.net/ajr/rtty/ remains quite active, with many of you stopping by daily. Check there for recent columns, the full list of software in the various RTTY Loop collections, links, and other goodies. I look forward to hearing from you by E-mail at ajr@ari.net, or on America Online at MarcWA3AJR, or on CompuServe at 75036.2501. Non-line amateurs, feel free to drop me a letter at the address up top. Questions, comments, suggestions or critiques are always welcome, but be sure to include a self-addressed, stamped envelope if you desire a personal reply by snailmail.

Next month, even more as we conclude the nineteenth year of RTTY Loop! 73

Photo D. Bob KI5PG, via the Internet with Snappy.

Ham Radio Fun

Communications Simplified, Part 5

by Peter A. Stark K2OAW
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Having looked at the types of signals we may want to communicate, let's look at some methods for sending them through wires and fiber optic cables. Some of the methods we will describe depend on ideas and concepts which we will not cover until later; hence this discussion will be fairly low-level. We will fill in some more details later, as we learn more about the theory. (Continued from April 1996.)

Normal telephone circuits

Normal telephone service (often affectionately called *POTS* or *Plain Old Telephone Service*) uses 600-ohm balanced line and carries analog signals (as opposed to the newer digital lines, discussed later.) The cable carries audio in both directions at the same time, and this is called *full duplex* (as opposed to *simplex,* where a signal goes only one way, or *half duplex,* where a signal can go in both directions, but in only one direction at any given time.) Since audio goes both ways and distances tend to be long, the cable must be terminated in its characteristic impedance at both ends. Thus your telephone set is designed to have a 600-ohm impedance, and so is the circuitry in the phone company's central office.

Telephone lines come in two different types—*switched* and *dedicated* or *leased*. Your normal household telephone connects to a switched line, meaning that it connects to the phone company's switching circuits, which allow you to dial a number and be connected, through the switching circuits, to any other subscriber's telephone (*subscriber* is simply another word for customer). This dialing network (or switching network) is also sometimes called the *DDD* or *Direct Distance Dialing* network.

A leased line, on the other hand, bypasses the switching circuits and is directly and permanently connected between two subscribers. Rather than pay for such a line by the call, you pay by the month.

Since switched lines go through a lot of equipment, they generally have a limited frequency response, and substantial noise and distortion.

Moreover, each time you place a call, your connection is likely to go through a different route, so the noise and other distortions are different with each call.

Leased lines, on the other hand, always go through the same wiring, so their characteristics stay the same. They also bypass much of the circuitry that distorts signals or adds noise. Not only is signal quality better to begin with, but that also means that either the telephone company, or the user, can add additional equalizers and other circuits to improve the line even more. Such lines cost more, but can be used in places where a plain line cannot. For example, radio stations often rent such equalized lines (called *conditioned* lines) to carry high quality audio from their studios to their transmitters.

The above description holds quite well for short-distance connections (such as within a small town), but the picture changes when longer distances have to be covered and the signal gets too weak to make it without amplification. It is possible to insert a bi-directional amplifier into a full duplex line (meaning that the amplifier can amplify two signals traveling in opposite directions on the same line at the same time), but this introduces some other problems. For long-distance transmission, the telephone company therefore splits the full-duplex single line (usually two wires) into two simplex (one-directional) circuits; since this involves a total of four wires, it is called a *four-wire circuit.* This conversion is done with a device called a *hybrid* or *duplexer*. Once split into a four-wire circuit, the two simplex signals can be sent via wire, microwave radio, optical fiber, satellite, or virtually any other one-way medium.

The two-wire line which enters your home or business is generally called the *local loop*, while the four-wire line which carries the call between telephone company equipment (and other lines as well, which might be used not just for your conversation, but for others as well) is called a *trunk*.

Digital telephone lines

As of right now (1996), the telephone line—the local loop—entering your house is purely analog, meaning that the signal traveling in it is a wave shape which closely matches the wave shape of the sound of your voice. Many telephone lines, however, are purely digital.

Since even a moderately long telephone connection uses a four-wire trunk line at some point, carrying a separate set of four wires for every telephone call between large cities could obviously get very expensive. The telephone companies therefore send many different calls through a single cable at the same time, using a process called *multiplexing*.

Early multiplexing techniques were analog; the multiplexer at the sending end would change each signal into a different frequency range, and the modified

signals were then all sent through the same cable. At the receiving end, a *demultiplexer* would separate the signals, and change them back to the original frequency ranges. This concept was called *frequency division multiplexing* or FDM.

But FDM is an analog approach which is subject to noise and distortion. In an effort to reduce these effects, especially when a signal is sent through some combination of cables, microwave links, and other paths over a long distance. FDM has now been replaced by a digital approach. Right now, the actual local loop going from your home to the telephone company's central office is still an analog 600-ohm line. In the central office switching circuits, however, that signal is then converted to a digital signal by a *codec*, which is a coder–decoder circuit which converts to and from digital. The signal stays digital all through the network, until it is converted back to analog by another codec in some distant central office and sent to the person you are speaking with through his local loop.

In long distance circuits, the basic digital connection is called a *T3 digital carrier system*, which transmits digital data at a rate of 47.736M bps (47.736 million bits per second.) The T3 line can then be split into seven T2 lines, which operate at 6.312M bps; these in turn can be split into four T1 lines, which operate at 1.544M bps. Each of these can in turn be split into 24 digitized voice channels. (You will note that these numbers don't exactly multiply out to the correct values; that is because each of these T lines also carries some signaling bits.) A T1 line can therefore carry 24 voice channels at the same time, a T2 line can carry 96, and a T3 line can carry 672 voice channels.

The change to a digital network was actually driven by another problem. In order to tell the circuits at the far end of a connection how to route a call, the telephone companies needed to send additional signals through long-distance circuits. The original approach was to send these signals as audio tones (similar to the Touch-Tone tones we now use for dialing, but at different frequencies) right through the same circuits as the phone calls themselves. But some time in the 1960s or 1970s, telephone hackers called *phone phreaks* learned how to fake these tones, using a device called a *blue box*, to make free phone calls. The only way to eliminate this practice, as well as provide new services such as Caller ID, was to provide a completely different data path for the signaling signals, separate from the audio path, so there would be no way for a hacker to inject fake signals into the network. This has resulted in a complete redesign of the long distance network, making almost all the trunk lines, both those for digitized audio as well as those for signaling, completely digital.

If you have a lot of digital data to send, you can lease a T1 line, or a part of a T1 line (called *fractional T1*). Right now, this is a fairly expensive proposition which requires special wiring, so it is used only by larger businesses.

To lower the cost, a new system called ISDN or the *Integrated Services Digital Network* is being installed in larger US cities, as well as in many countries overseas. The idea is to bring a digital connection directly to your home or small business through the same twisted pair (refer to April's *Communications Simplified*) now used by the local loop connections, and put the codec directly into your telephone. This not only improves the quality of the connection — since it eliminates the last analog lines which might pick up noise — but also makes it possible to use the same lines for high speed digital non-voice applications.

The "Basic ISDN" connection, suitable for a home or very small business, is a single local loop twisted pair line which carries data at 144K bits per second. This is split into three channels, two at 64K bits per second and one at 16K bits per second. The 16K bps channel can be used for signaling or data, while each of the two 64K bps lines can carry a voice channel, FAX, or even high speed computer data.

A higher-speed ISDN connection, called "Primary ISDN," is available for larger businesses; it operates at 1.544M bps (like a T1 line), and can be split into 24 digital channels.

Although ISDN is here and now, it is only gradually being introduced. For example, even in New York City it is only available in some relatively small areas. But that will probably change in the future, especially since the local loop wiring is a big part of the telephone company's investment. Since ISDN basically doubles the number of voice channels that can be used on each local loop, there are great advantages in using it.

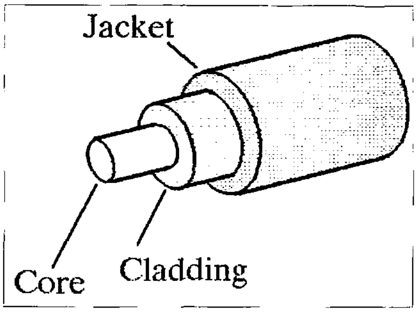


Fig. 1. Construction of an optical fiber cable.

Before going on, we shouldn't forget the other company that is in a position to offer you telephone service — your local cable TV company. Since so many homes are already wired with high-quality coax cable for cable TV, the cable companies are actively working on using those same cables for telephone service. One of the major hangups has been how to interconnect the cable companies' telephone subscribers with those of the traditional telephone companies, but in early 1995 there were several agreements between cable and telephone companies on how to do that. The major point of agreement was to allow subscribers to change companies without having to change their telephone numbers as well. This problem has been resolved, and so it's quite likely that "cable telephone" service will be around soon, especially since Congress has recently passed the 1996 Communications Act, which permits all sorts of new competition.

Radio-frequency signals

Just like audio signals can be sent through either shielded unbalanced cable, or through balanced cabie, so can radio-frequency (RF) signals. But at the high frequencies used for radio signals, most cables wind up being quite long compared with a wavelength, and so it is important to pay attention to the impedance of cable, load, and source, to avoid reflections.

Relatively little balanced cable is used for RF. The most common one is the thin "twin-lead" cable used for TV antennas, which has a characteristic impedance of 300 ohms. Because balanced cable can have a lower loss than coax cable in some applications, balanced cable is also sometimes used in other places, but not

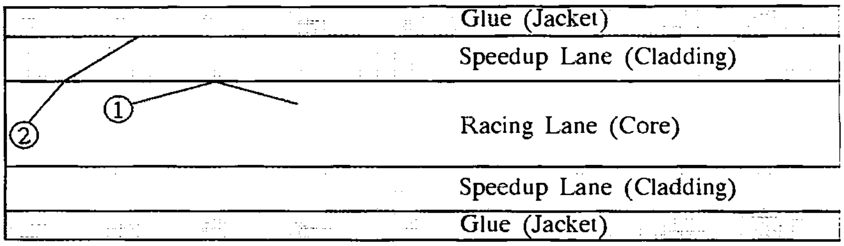


***Fig. 2.** The cladding steers light back into the core.*

as often. Most coax cable is 50-ohm or 52-ohm cable (the difference is unimportant). Some 75-ohm cable is used, but mostly in TV antennas and cable TV installations. The reason TV uses 75-ohm cable rather than 50-ohm cable is that 75 ohms is exactly one quarter of 300, which makes it slightly easier to convert back and forth between the two types of TV antenna cable.

At extremely high frequencies, the insulators used for balanced or coax cables have too much loss, and so a special kind of "rigid cable" is used which has no insulator at all, other than air. It is called waveguide, and is actually more a pipe than a cable.

Keep in mind that high-speed digital signals behave somewhat like high-frequency radio signals. Hence all the cautions about watching the characteristic impedance of lines, and properly terminating them, are also important for digital applications. For example, the coax lines used for LANs (local area networks used with computers) also need to be properly terminated. Many LANs use coax lines (both 50-ohm and 93-ohm), although unshielded twisted pair (UTP) lines are also popular.

Optical fibers

As fiber optic cables fall in price, they are being used more and more for communications. In a nutshell, electrical signals are converted into a light beam (possibly visible, but more likely infrared) with an LED (light-emitting diode) or laser, the light beam is sent through a fiber made of glass or plastic, and then converted back into an electrical signal with a photodiode or phototransistor. Thus the fiber cable simply replaces the copper wire.

A major difference, however, is that optical fiber communications are almost always digital. The reason is that it is easy to switch a light beam on and off, even at high speed, to carry digital data. But to carry analog data directly would require that the brightness of the light be varied in step with the analog data: this is difficult to do with any degree of precision.

Fiber optic cables can be made of either glass or plastic. A typical cable generally looks like **Fig. 1**, and consists of three parts:

a. The *core* is at the center. Made of very pure and clear glass or plastic, the core passes the light beam from one end of the fiber to the other.

b. The *cladding* is a second layer of glass or plastic, wrapped around the core. This layer is made of a slightly different glass or plastic, one that lets light travel just a bit faster than the core.

c. The *jacket* covers the outside of the fiber and protects it.

To understand how this works, imagine that we are laying out a race course for blind runners. Since the runners can't see, how can we keep them from wandering outside their lanes? One way, of course, would be to put a picket fence at both edges of the lane, but that's not very humanitarian — every time a runner hits the fence he will get all scratched up or bloodied, and pretty soon he will give up.

So we come up with the brainstorm of **Fig. 2**. First we lay out the actual lane, labeled the racing lane in **Fig. 2**. On each side of the racing lane we put a second lane made of a slightly different material, one which gives the runners slightly better traction so they can run just a bit faster on it. This is labeled the speedup lane in the figure. Finally, at the very edge, just in case a runner gets too far off course, we'll put a layer of glue to stop him so he can't wander back into the course and get in someone else's way.

So now look at runner 1, who's running at a slight angle to the course. As soon as he enters the speedup lane, his left foot will have slightly better traction than his right foot, so his left side will wind up traveling just a bit faster. This is going to turn him slightly to the right, so he goes back into the racing lane. Runner 2, on the other hand, is so far off course that he too will turn a bit to his right, but not enough to return to the course. He will eventually get stuck in the glue, and that will keep him out of trouble.

So the whole idea is that the speedup lane keeps the runners from straying off course, without in any way hurting them or slowing them down. The optical fiber works exactly the same way. The cladding is made from a glass that lets light travel just a bit faster than the core. When a ray of light tries to leave the core and enter the cladding, it gets bent back just enough to re-enter the core. If it's like runner 1, it returns to the core and keeps going. But if it's like runner 2, then it goes right through the cladding until it hits the jacket, and gets stopped.

Although the best cables are all glass, they are also available in pure plastic, or in plastic-clad silica (PCS) cables which have a plastic cladding and a glass (silica) core. The glass cables perform much better, but also cost much more. The following table lists some of the characteristics of a few different kinds of fiber cables:

Type	Attenuation (dB/km)	Bandwidth (MHz-km)
Glass	0.5	1000+
PCS	10	20
Plastic	400	20

Table 1.

Let's look first at the attenuation of these three sample cables, and compare them with copper cables.

The attenuation of various copper cables increases with the frequency of the signal. For example, good quality RG-8 with a foam dielectric has about 1.2 dB loss per 100 feet at 50 MHz, about 2 dB loss at 150 MHz, and 3 dB loss at about 300 MHz. Let's look only at the loss at 50 MHz, since that is close to the 47.736 MHz data rate of a T3 line.

Since there are about 3300 feet in a kilometer, a 1 km length of RG-8 would have about 40 dB loss at 50 MHz. Even one of the best and most expensive coax cables (7/8-inch diameter hard-line) would have a loss of 12 dB per km at 50 MHz. Compare this with the 0.5 dB per kilometer loss of a good glass optical fiber.

The attenuation determines how long a cable can be used before the signal becomes too small to be useful. Because of their low loss, the maximum usable length of a plastic fiber is a few hundred feet — long enough to go within a building, but not much more. PCS fiber cables, and coax wires, can be used for a few km, while high quality glass fibers can go 30 km or more. In a long distance circuit, such as the telephone company might use between cities, repeaters must be placed at intervals to amplify and reconstruct the digital signal. When a glass fiber is used, these can be much farther apart than when a copper cable is used — sometimes as much as 20 to 30 miles apart.

Another aspect, of course, is the bandwidth. The bandwidth of an optical fiber is rated in "MHz-km." For example, for a plastic fiber, this number is 20 MHz, meaning that a 1 km length (about 3300 feet) has a bandwidth of 20 MHz, a 0.5 km length has a bandwidth of 40 MHz, while a 10 km length would have a bandwidth of just 1 MHz. This makes it look as though plastic cable doesn't have nearly enough bandwidth for any real digital data transmission. But because plastic cables are only used in short lengths, their bandwidth is adequate.

But look at the bandwidth of the glass fiber, shown as more than 1000 MHz-km. Even in long lengths, glass fiber has a large bandwidth. It can carry many more voice conversations, for example, than a copper cable. There are systems that can carry as many as 30,720 telephone conversations in one cable, a feat which cannot be done with copper cables.

As a result, even though glass fibers cost much more than even good quality coax cable, their higher bandwidth, and the ability to go longer distances between repeaters, outweighs their higher price and makes them attractive.

Decibels

We have used decibels (abbreviated dB or sometimes dB) in the previous section, without really explaining them. Decibels or dB are important enough that a mere detour to cover them is not enough, so here is a more complete explanation.

The decibel originated in the telephone industry. The prefix *deci* means a tenth, so a decibel is really a tenth of a Bel, a unit named in honor of Alexander Graham Bell, the inventor of the telephone. But the Bel is too big a unit for most uses, so everyone uses decibels instead.

The decibel is usually used to compare an "after" with a "before." For example, we might compare the power after an amplifier (coming out of it) with the power before it (the power going into it.) The formula is then dB = 10 $\log_{10}$ Power after/ Power before (the factor of 10 converts the Bels into decibels.) The ratio of Power after/Power before is often called a *power gain ratio* or just plain gain ratio.

For example, if an amplifier takes a 1-watt signal and amplifies it to 100 watts, the gain would be dB = 10 $\log_{10}$ 100/1 dB = 10 $\log_{10}$ 100 and since the $\log_{10}$ of 100 is 2, the answer is 10 x 2, or 20 dB.

You've probably forgotten that $\log_{10}$ means the "logarithm base 10." This is the "power to which you'd have to raise 10" to equal 100. In this case, $100 = 10 \times 10 = 10^2$, so to make 100, you have to raise 10 to the second power. Hence the logarithm of 100 is 2.

If you have a modern scientific calculator, calculating logarithms is a lot easier than when I was in school. Still, we can save ourselves a lot of work if we make up a table like this:

Power Gain Ratio	db
100,000	+50
10,000	+40
1000	+30
100	+20
10	+10
2	+3
1	0
0.5	-3
0.1	-10
0.01	-20
0.001	-30
0.0001	-40
0.00001	-50

Table 2.

The important thing to notice is that when the power gain ratio is larger than 1—which means that the power after is larger than the power before—the number of decibels is positive. On the other hand, if the power gain ratio is smaller than 1—which means that the power after is smaller than before—the number of dB is negative. Therefore a positive number of dB means a gain, whereas a negative number of dB is a loss. (By the way, -3 dB represents a power gain ratio of 0.5, and so many people refer to -3 dB as "half power.")

For example, we said earlier that a 1 km length of foam RG-8 cable would have about 40 dB loss at 50 MHz. That translates to -40 dB (negative because it is a loss), so the power gain ratio is 0.0001. That means that the power after the cable is only 0.0001 times as large as the power going in. If you sent 1 watt into the cable, only 0.0001 watt would come out after just one kilometer, or about 3300 feet.

Compare that with glass fiber, which has a loss of 0.5 dB (which is really -0.5 dB) per kilometer. In six kilometers (about 4 miles), this adds up to -3 dB, and the above table tells us that is a gain ratio of 0.5. This means that the power coming out of a 4-mile length of glass fiber is half of what went in. This is an astounding number—just visualize how clear a piece of window glass would have to be if it were 4 miles thick, yet half of the light going in would still come out the other end!

Besides comparing powers, decibels can also be used to compare voltages. But in this case the equation has a 20 instead of a 10 in front of the log, and it becomes dB = 20 $\log_{10}$ Voltage after/ Voltage before.

This makes all the dB values twice as large, and gives us the following table:

Voltage Gain Ratio	db
100,000	+100
10,000	+80
1,000	+60
100	+40
10	+20
2	+6
1	0
0.5	-6
0.1	-20
0.01	-40
0.001	-60
0.0001	-80
0.00001	-100

Table 3.

For example, if an amplifier takes 1 volt in and produces 10 volts out, the voltage gain ratio would be 10, and so the gain would be +20 dB. As before, positive values are a gain, while negative values mean there is a loss.

My students often ask why we use decibels at all, when we could leave gains expressed as ratios instead. The main reason is that it makes calculations a lot easier when a signal goes through a chain of circuits, one after another.

For example, suppose a signal goes through an amplifier with a power gain of 100 (+20 dB), then through a volume control which drops the voltage in half (-6 dB), and another amplifier with a power gain of 10 (+10 dB). Figuring out the gain of the entire chain is easy with decibels — we simply add +20 -6 + 10 = 24 dB. If we try to do it with gain ratios, we get all bollixed up because the amplifier gains are given as power gains, but the volume control is described in terms of voltage.

If you have the patience to see how this would work, here goes: since the formula for power is $P = V^2/R$ the power is proportional to the square of the voltage. Cutting the voltage in half (in the volume control) therefore cuts the power in a quarter. The power gain ratios would then be multiplied as 100 times 1/4 times 10, which gives 250. When we plug this into the dB formula, we get $dB = 10 \log_{10} 250/1 = 10 \log_{10} 250 = 10 \times 2.4 = 24$ dB.

How do we convert from dB back to a plain ratio? This isn't done nearly as often as converting to dB, but it still is useful to know. Let's do it for the 24 dB answer. First, assume R stands for the gain ratio, so we have: $24 = 10 \log_{10} R$.

Next, divide both sides by 10: $2.4 = \log_{10} R$.

We now remember that the log of a number is the power to which we must raise 10 to equal the number. So 2.4 is the power that we have to raise 10 to equal R. That is, $10^{2.4} = R$.

We really need at least a calculator to get this answer; the best we can do without the calculator (or at least a book of tables) is to try to approximate. Since $10^2 = 100$ while $10^3 = 1000$, at least we can estimate that $10^{2.4}$ must be somewhere between 100 and 1000, probably closer to 100 than to 1000.

Conclusion

Communications over wires is the oldest form of electric or electronic communications, but it is still in wide use all over the world. And it's not likely to ever be replaced, even though optical fibers are making great inroads.

In fact, with today's ever-increasing need for more and more communications, wires and fibers are becoming more important than ever. While it would be nice to use "wireless" methods like radio, there are severe limits to the amount of information that can be sent in this way; there is just not enough space for everyone that wants to use it.

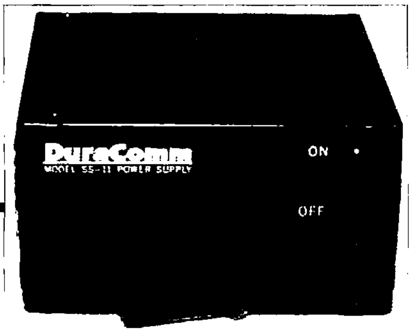
One of the biggest users of scarce radio space is TV. Some years ago, several TV channels were taken away from TV and reassigned to other uses (such as cellular phones); with the expansion of cable TV and satellite TV, this may even happen again.

Number 43 on your Feedback card

73 Review

The Ten-Tec SS-11 Switching Power Supply

Neat, compact, lightweight.



Joseph M. Plesich W8DYF
173 Brockton Road
Steubenville OH 43952

What I needed was an AC supply capable of powering my Ten-Tec Argosy II. It's a great little transceiver that runs 50 watts on CW and SSB, so I needed something more practical than the 11-pound monster I had on hand.

While reading the advertisement for the Ten-Tec Scout (which I hope some day to own), I noticed that one of the supplies available for it is a little three-pound 11- amp supply. If it would power the Scout, it would certainly power my Argosy. I ordered it.

The SS-11 supply converts 120 or 240-volt 50/60 Hz AC to low noise and ripple regulated 13.8V DC. The operating voltage is selected by a switch on the rear panel. The power supply is protected against inadvertent shorts and overloads by an electronic output current limiter. This circuit reduces the output current to a very low and safe value until the overload is removed, when the output is automatically restored after the unit has been turned off for 15 seconds. It also has an over-temperature protection feature. The unit will provide 12 amps surge and 11 amps continuous duty and it measures only about 3"H x 6"W x" 5-1/2"D.

I've been using the SS-11 to power my Argosy and it doesn't even get warm. You could also use it to power a tape player, an FM or a QRP rig. It's a neat, compact, lightweight supply that's real handy around the shack. For $95, in my opinion, it's a very good buy from Ten-Tec: 1185 Dolly Parton Parkway, Sevierville TN 37862 or 1-800-833-7373.

Number 68 on your Feedback card

Homing In

Homing In Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92633

More foxhunts coming up — let's build a yagi!

Hardly a week goes by without hams telling me how much fun they had at Hamcon/Foxhunt-95. This international-style radio direction finding (RDF) contest, part of the ARRL Southwestern Division convention last Labor Day weekend, was one of the first such events ever staged in the USA. Despite the fact that Southern California is the transmitter hunting capital of the USA, a formal all-on-foot hunt under International Amateur Radio Union (IARU) rules had never been tried here before.

Perhaps you read about international-rules foxhunting and Hamcon/Foxhunt-95 in "Homing In" for December 1995 and January 1996. Many readers wrote or E-mailed to declare their interest in holding similar events in their localities. If the trend continues, it may soon be possible to establish an official foxhunting committee for IARU Region 2 (North and South America). Such a committee is necessary to sanction local foxhunts as qualifying rounds for future world championships.

If reading about Hamcon/Foxhunt-95 has made you eager to try this type of radiosport for yourself, plan now to attend the 1996 West Coast VHF/UHF Conference, May 3 through 5, near Los Angeles. In addition to the usual displays and technical sessions on propagation, mountaintopping, and contesting, this year's conference features both a traditional Southern California mobile T-hunt and an IARU-style foxhunt.

Both hunts are being sponsored by the Southern California Six Meter Club, the same group that put on Hamcon/Foxhunt-95. Transmitters will be on 2 meter FM. The foxhunt will begin Sunday afternoon at a site not far from the convention center. Don't forget your RDF gear!

Gather your sporting goods

I lost count of the would-be foxhunters who stopped by the sign-up table at Hamcon-95 to say they wished they could go on the hunt, but didn't have any suitable equipment. Actually, it's easy to get set for this type of RDF contest. You could build or buy a dual-switched-antenna "homing" device, as some competitors did. A few entrants brought special foxhunting beam-receiver sets made in Japan or Russia. But the majority of runners used the tried and true amplitude-based RDF method: just a directional antenna, RF attenuator, and handie-talkie with S-meter. Some carried full-sized three-element yagis, while others held wire quads, similar to the ones they like for mobile T-hunting.

The most intriguing antenna I saw at Hamcon/Foxhunt-95 was carried by Glen Allen KE6HPZ of the Downey Amateur Radio Club (**Photo A**). Its two closely spaced aluminum elements were about the same length. It looked like a phased array, but I couldn't be sure because its feed system was concealed in PVC pipe. Glen said it was a yagi. I figured that such close spacing would not give him much sensitivity, since high gain is normally associated with long boom antennas. Thus, I was truly impressed when KE6HPZ won first place in the Masters age division. In fact, he was the only one in his division to find all six foxes within the allotted time.

Photo A. Glen Allen KE6HPZ (second from left) had one of the smallest 2 meter RDF antennas at Hamcon/Foxhunt-95, but that didn't keep him from taking first place in his division.

KE6HPZ's yagi was designed by Doug Lyon N6WZI, a fellow Downey club member (**Photo B**). Doug told me that this antenna, which he calls the RDF², came about after he tried a number of multi-element yagis and quads and found them to be "too big and clumsy," to use his words. He set out to design his own model, one that would be light but sturdy, easy to build, compact and inexpensive. It had to have enough gain to hear distant milliwatt foxes and sufficient front-to-back (F/B) ratio to give sharp bearings.

"While reading the *ARRL Antenna Handbook*," N6WZI says, "I discovered that a parasitic element, cut as a director and placed about .05 wavelength from the driven element, provides a theoretical F/B ratio of nearly 30 dB. I was further surprised to read that at such close element spacing, theoretical gain approaches 5.4 dB. That was an unexpected plus. I kept expecting to find a snag, a problem characteristic. I had never seen this design in commercial or amateur radio use, so I assumed something must make it impractical."

Doug soon discovered that the biggest challenge would be matching a short-spaced yagi to 50-ohm coax. "The closer the director gets to the driven element, the lower the feed point impedance becomes," he says. "There is a negative reactance to be dealt with as well. I explored different feed systems including gamma, T and others. None seemed suitable. Then I read that a U-shaped loop (hairpin) will match antennas with impedances as low as 8 ohms."

Photo B. Doug Lyon N6WZI designed the RDF² antenna described in this article.

A typical hairpin match uses quarter-inch rods with 1-1/2 inch spacing. This approximates a 300-ohm transmission line. N6WZI successfully substituted TV twinlead to make a much more compact feed (**Photo C**). Physically, a hairpin is like a half-turn coil, so it is inductive. This is desirable for canceling out capacitive reactance at the feed point.

I was still unsure how Doug's close-spaced yagi with no reflector could give adequate gain and F/B ratio for foxhunting, so I modeled it with the ELNEC computer program. **Fig. 1** shows two directivity plots. The figure-8 pattern is for horizontal orientation with horizontally polarized signals. There are deep nulls at 90 and 270 degrees.

Turning the antenna to vertical orientation and tracking a vertically polarized signal source gives the outer elliptical pattern. Forward gain and F/B ratio are the same, but 3 dB beamwidth increases from ± 36 to ± 70 degrees. The side nulls disappear, but they won't be missed. Signal reflections from nearby terrain objects tend to fill pattern nulls on 2 meters, so it's best to take RDF bearings using the forward lobe instead of the nulls.

ELNEC assumes that this yagi is in free space. It takes into account the diameter of the aluminum elements and their skin-effect losses. It predicts 17.7 - 54.6 ohms complex feedpoint impedance at the design frequency (146.565 MHz). This is the value that is matched to 50-ohm coax by the hairpin. Gain is above 4.7 dBi and F/B ratio is above 8 dB over the entire 2 meter band.

N6WZI chose 1/4-inch solid aluminum rod for elements. He says, "I used grade T-6061 aluminum at a slightly higher price

because it is less apt to bend than ordinary rod. With such close spacing, construction must be sturdy so that element positions remain constant. I chose 1/2-inch PVC Schedule 40 water pipe for boom and element supports. A block of 3/16-inch thick insulating material such as hardwood or plastic centers the rods in the PVC tee and cross connectors."

The TV twinlead hairpin match is shorted at one end and connected to the two halves of the driven element at the other (**Photo D**). Length is 1-5/32 inches. It must be formed along the boom toward the driven element for lowest SWR. N6WZI measured 1.6:1 SWR at 146.565 MHz. It was under 2:1 over the entire 2 meter band. I tested the RDF² in a clear area and found its F/B ratio to be approximately 14 dB.

You should be able to build the RDF² for under $12 in materials. Overall driven element length is 37-9/16 inches. Director length is 37-3/16 inches. The model in **Photo C** is a special "cutaway" version illustrating how elements are mounted inside the PVC fittings. For a rugged water-resistant antenna, do not cut the PVC junctions. Simply assemble the antenna into the fittings.

Assembly instructions

Cut a 37-3/16 inch length of aluminum rod stock for the director and two 18-5/8 inch pieces for

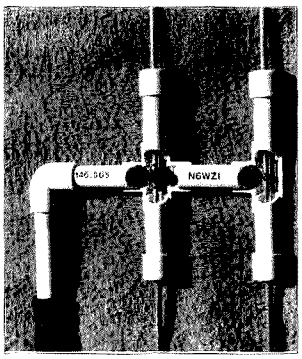


***Photo C.** N6WZI made this special cutaway version of the RDF² to show how it goes together. Each of the six short PVC pipe sections is three inches long. The driven element is in two sections; the gap between them is obscured by the twinlead matching section.*

the driven element. Fabricate two 1 x 1/2 x 3/16 inch support blocks. You will also need 28 inches of 1/2-inch Schedule 40 PVC pipe, one each 1/2-inch tee (T), cross (X), and elbow (L) slip fittings, and PVC cement.

Drill the director rod at its center with a 7/64-inch bit to accept a 4-40 x 3/4-inch screw. Referring to **Photo C** for location, drill a 7/64-inch hole through the PVC T fitting. Feed the director into the T and mount it inside on its support block, similarly drilled. Secure all with a 4-40 machine nut and lock washer. Use a little hot melt glue or household glue to seal the nut in place. Cut two 3-inch pieces of PVC pipe and cement into each end of the T. Drill 1/4-inch diameter holes through the center of two PVC end caps, slide these over each end of the director and cement to the 3-inch PVC pieces. This completes the director element.

Drill each driven element rod section at 5/32 inch from one end with a 7/64-inch bit. Drill the driven element support block with a 7/64-inch bit at 9/32 inches each side of the center. These holes will be 9/16 inch apart, to provide 1/4-inch spacing between the legs of the dipole.

With 4-40 x 3/4-inch machine screws, use the drilled insulating block as a jig. Prepare two solder lugs by trimming the tabs to 1/16 inch. Place solder lugs over the screws and solder the two leads of the unshorted end of the hairpin in place, one to each lug. Now solder on a 64-inch length of RG-58 coax, center conductor to one lug and shield to the other. Trim excess wire and lift off the complete assembly.

With a 7/64 inch bit, drill two holes through one side of the PVC X, using the drilled driven element insulating block as a pattern. Now assemble all the parts (coax, hairpin, solder lug assembly and insulating block) inside the X. Put the screws part of the way through from the outside of the X, then place the insulating block inside and over the screws. Put a dipole end over each screw. Now put the solder lug/coax/hairpin assembly in the X and over the screws, feeding the coax through the X at 90 degrees to the dipole elements. Face the hairpin toward the director element inside the X. Secure all with 4-40 machine nuts and lock washers. Use glue to seal the nuts.

Cut a piece of 1/2-inch PVC pipe to three inches in length and cement it between the director T and the driven X. This provides four inches (.045 wavelength) spacing between the driven element in the X and the director element in the T. Be sure to align the elements parallel to each other. Make the handle from an elbow fitting, 3-inch and 10-inch length of PVC pipe, then cement it in place. The coax goes through the pipe and out the bottom. A bicycle handle grip held with a small sheet metal screw finishes the antenna.

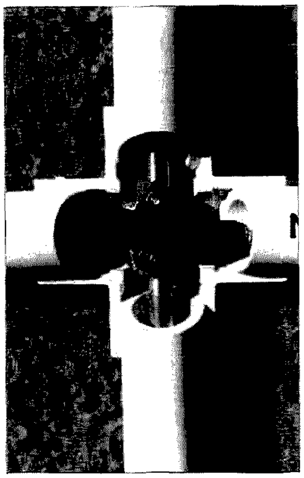


***Photo D.** Close-up of the driven element feed point showing the supporting wood block, coax connection and hairpin match stub.*

A one-afternoon project

The RDF² is so easy to build that it would make a great group project for your club. Plan a short foxhunt soon after the construction party so all builders have a chance to try out their yagis and experience the thrill of finding radio foxes.

As of this writing, N6WZI is not in the antenna-building business, but he is considering making RDF² parts kits available, if there is sufficient interest. Write to him at the address in the sidebar for more information. Please enclose a self-addressed stamped return envelope with your request. (*73* columnists appreciate this courtesy, too.)

A compact yagi is ideal for more than foxhunting. For example, you could use it to pinpoint sources of electrical noise around the neighborhood. N6WZI realized that it might be useful for search/rescue workers seeking aircraft Emergency

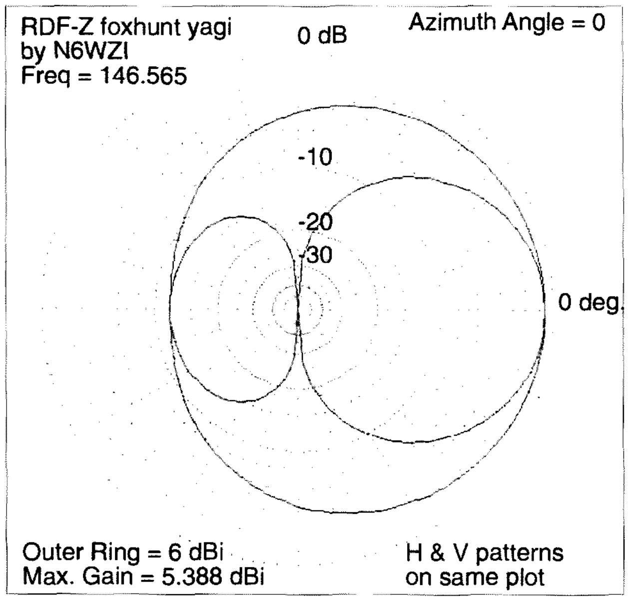


***Fig. 1.** Calculated horizontal and vertical polarization patterns for the RDF². ELNEC shows that its F/B ratio is higher than the classic three-element National Bureau of Standards yagi, which has eight times greater total spacing.*

Locator Transmitters. "I made a prototype scaled to 121.5 MHz for Bob Miller N6ZHZ of the Civil Air Patrol," Doug told me. "Bob used it with such good results that I got a call from a Captain wanting to know how they could get some more. I built another six and shortly after I delivered them, I got a phone message stating that they had been instrumental in the timely location of a downed aircraft."

Caution: For ruggedness in the field, this yagi has rigid elements, firmly attached. When the antenna is oriented vertically, falling on it could cause injury. Children should be trained to hold the antenna so as to minimize this danger. If the user will be running while holding it, attach one-inch diameter solid spheres to the four element ends and wear protective goggles. Always keep safety in mind when foxhunting.

Join me for a weekend of fun at the VHF/UHF Conference. I'll be presenting a slide show Saturday morning on the joys of foxhunting. With any luck, we'll fill the woods with fox trackers Sunday afternoon. I want to hear about RDF contesting in your area, so write and send photos to the address at the beginning of this article. Send E-mail to Homingin@aol.com or 75236.2165@compuserve.com.

This Month's Resources

The 1996 West Coast VHF/UHF Conference will be at Gateway Plaza Holiday Inn, 14299 Firestone Boulevard, La Mirada CA. Conference registration is $15 per person. Saturday night banquet, Sunday morning breakfast, and Proceedings book are available for additional charges. To register, send check to Southern California Six Meter Club, P.O. Box 10441, Fullerton CA 92635. E-mail conference inquiries to rhasting@ix.netcom.com. Call (714) 739-8500 for hotel reservations.

Send RDF² yagi kit inquiries to Doug Lyon N6WZI, 11905 Cresson Street, Norwalk CA 90650.

ELNEC antenna analysis program for PCs is available from Roy Lewallen W7EL, P.O. Box 6658, Beaverton OR 97007. Write for prices.

NEVER SAY DIE
Continued from page 61

even Pons and Fleischmann, the discoverers of the cold fusion effect, have been able to get any patents issued making a claim of over unity energy.

What does this mean to you? Well, that depends on how alive you are. How interested in learning new things. Maybe even trying them. A Manitoba reader called a few days ago to say that when he read about this cold fusion stuff he set up a simple tabletop experiment using nickel. He got 33% excess heat and was hooked. He said he tried gold instead of nickel for the cathode and improved his output by about five times, so now he's heating his greenhouse with a small cold fusion cell.

Well, you can see why I'm excited about this.

Dennis Cravens, a young physics teacher at a small Texas community college (Vernon), is the leading American researcher in the field. His lab cost him under $5,000 over a period of five years. He's recently moved to New Mexico, set up a small lab there, and is working with Dr. Patterson to develop his patented cell. Some business giants are starting to take note.

It didn't hurt when "Nightline" devoted a half hour in early February to interviewing Dr. Patterson. Plus a short interview segment on "Good Morning America."

The Jan. 23rd piece in the *Wall Street Journal* by Jerry Bishop reported on the December Power Gen conference demo by Patterson and Cravens, but kept repeating the old critic refrain that nobody knows why excess heat is happening, and that it is preposterous to claim it is fusion. But then these same hide-bound scientists refuse to accept that fusion is constantly taking place in living cells, so they need to get off their high horses and read more.

I've had to start remembering some of my fundamental chemistry from college. If you fuse lithium and hydrogen you get beryllium plus some lost matter (energy = heat). When you fuse this beryllium with another hydrogen you get boron plus some more lost matter (energy = heat).

Scientists often tend to be so solidly imprinted with what they learned in college that almost no amount of contrary evidence can break through. Max Planck commented on this phenomenon when he proposed quantum mechanics and it was rejected by the scientific establishment. Galileo had the same problem. Nothing has changed. Indeed, I see the same pattern in the medical field. It was this rigid thinking which killed most of the computer mainframe

Continued on page 75

New Products

Link Plus For Hams

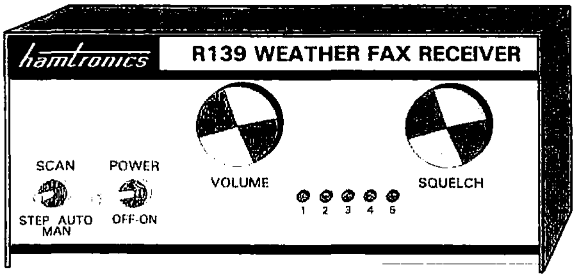
It used to be that you had to have a budget like the Pentagon's in order to afford signal processing equipment such as the LinkMate, but no more. Link Plus Corporation recently introduced the newest member of its family, specifically for the ham radio market.

The LinkMate uses Lincompex technology, in which the transmitter signal is compressed and the receiver signal is expanded, reducing noise and interference.

The marriage of the Lincompex technology and the digital signal processor technology provides a cost-effective alternative for interference reduction previously available only to military and government users.

Government tests have shown improvements ranging from 7 dB to 36 dB, with an overall average of 22 dB under "extremely noisy and unsettled atmospheric conditions."

For more information, contact Link Plus Corporation, 9052 Old Annapolis Road, Columbia, MD 21045. Phone (410) 995-1919. You can also see LinkMate at the Dayton Hamfest, booth #557.



Hamtronics Weather Satellite Receiver

Here's a cheap and easy way to receive weather fax information from the 137 MHz band—the Hamtronics R139 Weather Satellite Receiver. It's a wideband receiver specifically designed for this purpose.

Hamtronics combined the circuitry of the pervious R138/AS138 modules in one unit, with a cabinet and a power supply. Many customer suggestions were also incorporated in the new design.

The R139 is a crystal-controlled unit, with five settings that cover all the popular US and Russian weather satellite frequencies. The crystals are included. The channel can be controlled manually, or the unit can be left scanning for an active satellite.

That way, you can download and record transmissions for later output to a computer demodulator. LEDs on the front panel indicate which satellite is received.

The module form of the kit is just $159; for another $30 you get a 12V power supply and an aluminum cabinet. If you're scared of your solder iron, or don't have the signal generator needed to align the kit, you can buy one wired and tested for $239.

Contact Hamtronics Inc. at 65-D Moul Rd., Hilton, NY 14468-9535, or call (716) 392-9430. Fax: (716) 392-9420. A complete catalog of all the Hamtronics kits, which range from VHF/UHF transmitters and receivers to repeaters, preamps and accessories, is available from the same source.

New HS-1000 All-Band HF Mobile Antenna

Mobile HF operators have a new choice of antennas. High Sierra Antennas has introduced its new HS-1000 all-band HF mobile antenna.

The design incorporates features such as new low-cost mounting options, center-loading coil for high-power and high-temperature applications, a decoupler system, and improved matching system and a remote control panel with limit indicator.

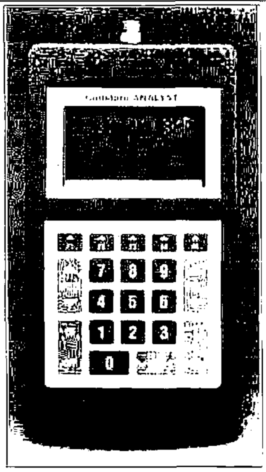
The antenna provides coverage from 3.5 MHz to 30 MHz and beyond without sacrificing performance on any frequency. The variable loading coil is remotely controlled, so the operator can tune the entire HF spectrum without leaving the driver's seat.

The HS-1000 uses two basic mounting systems. The easy-off mount allows the entire antenna to be removed in about 30 seconds for safety or security. This method uses a tapered stud at the base of the antenna together with an upper clamping mechanism.

The new single point mounting method allows the antenna to be attached to horizontal surfaces.

The antenna can be purchased as a complete package, or in its component pieces for those who already own some of the hardware from High Sierra Antennas, Box 2389, Nevada City CA 95959. FAX 916-273-7561 or telephone 916-273 3415.

Check Your Cellular Antenna Performance



Advanced Electronic Applications has released the CellMate Antenna Analyst, a hand-held diagnostic unit that provides comprehensive antenna performance information in an easy-to-read graphic format.

The CellMate covers the 806 to 960 MHz range continuously, graphically displaying antennas' VSWR vs. frequency plots on an LCD screen over a range from 1:1 to 10:1.

The unique LCD readout graphically plots the SWR curve over the entire frequency range, as well as at single frequencies.

CellMate is equipped with a serial interface for use with an IBM-compatible computer. With optional AEA software, users can store VSWR plots obtained by the Analyst in a PC for later reference, comparison or printing. You can even upload plots from the PC to the Antenna Analyst, and the Analyst's functions can all be controlled from the PC as well.

For more information, contact AEA at (206) 774-5554.

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Michael Bryce WB8VGE
2225 Mayflower NW
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Radio Magic

by Michael Bryce WB8VGE

Let's set the Wayback Machine to 1975, when a very popular construction project was the W4VVF electronic CW keyer. This keyer did all kinds of things that were unheard of then. It sported such goodies as dot-and-dash memory, iambic keying, and solid-state output keying. The keyer consisted of five TTL chips and a handful of other parts. The whole shebang went on one single-sided PC board. There were zillions of these things built by hams. Including me. I had the distinction of assembling one and never getting it to work.

After weeks of troubleshooting, I got so mad at the keyer, I took a three-pound hammer and beat the keyer, ICs and all, into the top of my workbench. While I didn't figure out what I did wrong, I sure had a case of the warm fuzzies after smashing the poogies out of it. To this day, there are still hunks of that project oozing out of the workbench. Ah hah! I hear you saying. So you had The Kit From Hell, too!

Not one to give up, I ordered another PC board and started over again. This time the keyer worked as it should have and I went on to assemble dozens more for various friends and members of the local radio club. What did I do differently the second time around? I asked for help.

As it turned out, there was a mistake in the schematic that caused the bug. Armed with this knowledge, it was a simple matter to correct the error and produce a working keyer. I would have never been able to track down the problem by myself. So, after exhausting all your options, sometimes a note to the company that packed your kit may solve your dilemma. It's always to your benefit to inform the company of a missing step or error in the assembly instructions of the kit. In fact, when you contact the company, they may have several "fixes" available to enhance the operation or assembly of the kit. Don't be afraid to ask for help!

"I got so mad, I took a three-pound hammer and beat that keyer, ICs and all, into the top of my work bench."

Go ahead...touch it

With that out of the way, let's do a little bit of signal tracing. In a receiver, the best place to start is at the input to the audio amplifier. All you need is a fingertip. Of course, don't try this trick if your receiver is being powered by 110 volts. With your fingertip, touch the center terminal of the volume control. If the audio circuits are working as they should, you will hear a load buzz coming from the speaker.

Work your way back toward the antenna. Check for the proper operation of key oscillators such as the BFO and mixers. The VFO should be running as well as the local oscillator. You may need to use a frequency counter or an oscilloscope to check these stages for proper operation. Getting your kit to work takes only a matter of time while working out a few steps in the troubleshooting process.

Projects from the pages

When building a project out of a magazine, it is usually up to the reader to supply all the parts. In some cases, the author may have specified a particular part that not only has the required electrical specifications but also physical characteristics needed to fit the PC board. Usually, the author will have at least one source for all the parts needed to duplicate the project. Be sure that "oddball" part has a source.

Don't forget to check for any software or EPROM that need coding. Without the code, many of the projects won't work. And watch out for prices when dealing with source codes. A programmed micro-processor can be expensive.

73 Amateur Radio Today is one of the few ham magazines that still print the PC board foil pattern and silk screen. Many others request that a letter be sent to obtain the artwork. I suggest you purchase the PC board, if available, and forgo trying to make your own board.

In almost every case, someplace, somewhere, there will be an error in either the silk screen or the schematic. Errors usually happen when drafting the schematic from original artwork to what ends up in the magazine. No matter how many times it is checked for screwups, bugs do get in.

I once had a ham call me and insist that both the magazine that published the article and I had put in errors just so he'd have to buy the next couple of issues. That's just not true. No one wants mistakes to show up in a construction article, especially the editors and the authors!

So, keep in mind there may be nothing wrong with your project, even though it may not work correctly. I'd drop a note to the author. Be sure to include an SASE and ask if there are any errors in the plans.

Since you are your own kit builder when dealing with a construction article, you are free to change values of some parts to match what you have on hand. Unless the author states that certain components must be a specific value, you can change most values without getting into trouble.

Resistors are perhaps the easiest to change. There's not much difference between a 10K resistor and a 12K resistor when used to couple two stages together. The same is true for pull up resistors used to keep a logic high on the output of TTL and CMOS ICs.

You don't get to play with capacitor values as much as with resistors. For one, you don't have as large of selection in capacitor values as you do in resistors. Capacitors are usually selected to provide timing signals, bypassing at specific frequencies and to couple two stages together. Of course, changing the value of a capacitor used in a timing circuit (or oscillator) means the output of that timer or oscillator will be changed.

On the other hand, a capacitor used to couple two stages together can have its value changed without much thought as to circuit performance. If the construction article specifies a 47 pF capacitor, and your junk box yields only 33 pF, that's fine.

As long as you don't stray too far from the published specifications, go ahead and adapt the circuit to suit the parts you have on hand. A good dose of common sense goes a long way when you're building a project from a magazine article.

A 220 Super J-Pole Antenna

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Materials List

- 1/2" Copper Tubing (Cut one each of the following lengths): 12.5", 37.5", 25", 1 1/8" (for the cross bar), 1"-2" (for the base stub)
- 26" Length of 3/16" OD copper tubing or wire
- 2" #14 Stranded copper wire
- 1 1/2" Copper elbow
- 1 1/2" Copper "T" fitting
- 2 1/2" Copper end caps
- 2 3/4" Stainless steel hose clamps
- 12" Length of 1/2" birch dowel (for insulator)
- 1 SO-239 Panel mount coaxial fitting
- 1 1/2" Copper threaded fitting
- 1 1/2" Cast iron floor flange
- Tubing cutter
- Screwdriver
- Electric drill and bits: 5/64", 3/32", 3/16"
- Propane torch
- Solder and paste flux
- Electrical tape
- Drill press and small hobby file (both optional)
- Caulking or silicone compound
- 1 1/8" X 1 1/2" piece of thin sheet metal for soldering shield
- Steel wool or household scrubber pad (without detergent)
- Solvent
- Clear exterior spray
- VHF SWR Bridge capable of 225 MHz (borrow, if you don't own one)

NEVER SAY DIE

Continued from page 71

manufacturers and then wiped out most of the minicomputer companies. Where are Wang, Prime, Data General, and the others today? Even mighty DEC is fading away.

It's this pattern which has kept so many people and major companies missing the boat on new technologies. I might mischievously call this the CW mindset.

Our government does it again

One of the cutbacks of government funding has been the Navy research into cold fusion, which was going on in Washington, DC, and China Lake, California. Now, just as cold fusion has proven, even in its early research stages, to be everything promised, the Navy has stopped all further research funding. The Army and Air Force haven't been doing any research at all. Even the Electric Power Research Institute (EPRI) has cut research funding almost totally. Stanford Research Institute (SRI), funded by the Japanese, is moving ahead. Indeed, the Japanese have been increasing their cold fusion research funding every year. The Japanese have also funded Drs. Pons and Fleischmann, the pioneers in the field, and put a total blackout of news on their work.

So it sure looks like we're doing it again, setting ourselves up to lose the biggest industry yet. We lost the audio and videotape industries. We lost the compact disc industry. The TV and camcorder industries. Without any government scientific policy, big business in America is run by next quarter profits, so there's little incentive to invest in any long-range projects. And that's one of the big ways Japan has done so well.

Bio-nucleonics

Scientists have a blind spot when it comes

Continued on page 77

Number 76 on your Feedback card

BARTER 'N' BUY

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the May 1996 classified ad section is March 12, 1996.

NEVER SAY DIE

Continued from page 56

to anomalies. But I've been complaining to you for years about this, with no hint so far that I'm getting through.

It was my interest in anomalies that got me to follow up on a piece of weird science in the Tompkins-Bird book *The Secret Life of Plants*, which is on my recommended book list. They mentioned that chickens seem to be able to eat silicon and somehow turn it into calcium for their eggs. Transmutation? Shades of alchemy!

So I called Chris Bird and asked him about this. He put me onto a book by Louis Kervran, which was most fascinating. And that led me to Mishio Kushi and his book, *The Philosopher's Stone* (also on my list). All this was just my curiosity at work. I had no idea that it might lead to a possible explanation for the mysterious cold fusion reaction, which has been a matter of controversy for physicists and chemists for seven years now.

As I read these books, which confirmed the ability of living organisms (including chickens and humans) to transmute elements, it occurred to me that this might be what was responsible for all the anomalous heat the cold fusion researchers have been trying to explain.

It didn't take a lot of calculations to show that combining hydrogen and lithium to produce boron would result in a tiny bit of lost mass. We know from Einstein's $E = mc^2$ (where "c" is a huge number) that a little mass is equal to one heck of a lot of energy (heat). Somehow, in the crystal lattice structure of a few metals like palladium and nickel, this transmutation must be taking place. If more atoms were transmuted per unit of time we could have one heck of an explosion, so we're fortunate that Drs. Pons and Fleischmann discovered a very slow reaction.

I proposed this idea to the readers of my *Cold Fusion* magazine, who are some of the world's top physicists and electrochemists, expecting to get flamed for proposing something so dumb. Instead, I've been getting papers from scientists with equations showing how this is probably what is happening. We're waiting for spectrographic confirmation from two universities as to the elemental makeup of used cold fusion cells.

Louis Kervran, many years ago, did an extensive research project in Africa to check on the human transmutation of elements. He measured everything going into a group of men, and everything coming out (ugh!). His reports left no doubt that humans do somehow transmute elements. And this obviously has to result in the generation of some heat. Indeed, this might just turn out to be the major source of heat for us and all other living things. Bio-nuclear reactions. You can learn more about this by reading Kervran's book, *Biological Transmutations*, Swan House Publishing, 1972, 163p; ISBN 0-913010-03-0.

Well, somehow we mammals are turning food into heat. So where in the body is this happening? Where's the furnace? Can the transmutation of elements be the way we maintain our body heat?

In the cold fusion reaction, when we check the cathodes after use, we find microscopic pits. These could be the sites of transmutation, which would generate a lot of heat in a very tiny area as individual atoms transmute and convert the leftover matter into heat. If we find some silver, that would have had to come from palladium plus hydrogen. We'll see.

When I got interested in cold fusion a couple years ago I knew almost nothing about chemistry or nuclear physics. So I started reading everything I could find and asking endless dumb questions. And now I'm able to understand much of the stuff the theoretical physicists are writing for my magazine. I just wish I had the time to set up a small lab and do some research. I'd be surprised if I couldn't generate some high output over input devices using granulated or powdered nickel and a lithium electrolyte.

But then, I wish I had time to learn more about audio compacting algorithms so I could help develop some really narrowband real time audio. Maybe I can get you to do that? And write some articles as you pioneer? Let me put that another way: What have you read and learned in the last month? I've just ordered 30 more books by mail order. I'll let you know if any are really outstanding, and I'm pretty sure some will be.

Are you deaf?

Opportunity keeps knocking and you keep yelling for whoever it is to go the heck away and stop making all that racket. Ray WA2MMT sent me a recent newspaper clipping about a Boston doctor who managed to infect 19 of his patients with hepatitis B, despite wearing gloves while operating on them.

The first letter in the March *73* was from Ray, pointing out that most brands of latex gloves leak after about 20 minutes of use, so there is an opening for a simple gadget which could be connected to the doctor and the patient being operated on to indicate when a glove starts to leak. The medical market is a whopping one. After all, it's a trillion-dollar industry, so medical electronic gadgets command a premium price.

I remember when Wes Schum W9DYV got forced out of his Central Electronics business, a victim of the loss of our whole ham industry in 1964. He went into medical electronics and instead of just barely making a go of it, he was making money hand over fist.

He'd had to sell his small manufacturing business to a larger company a couple years before because he didn't have enough money to keep up with its growth. It all hit the fan when he announced a new rig which cost him about $400 to make. He quickly had thousands of orders on hand and not nearly enough money to buy the parts for that many rigs. The banks couldn't care less about his orders, so he had to sell his business just to keep going.

Then the 1964 "Incentive Licensing" catastrophe hit him, as it did every other ham manufacturer.

When you read Ray's letter in the March issue did you dash to your workbench to see what you could do, or did you ho-hum it and pick up *TV Guide*?

On the bright side for the 19 infected hepatitis patients, and the doctor, if they buy or make one of the Bob Beck gadgets, unless Bob faked a whole stack of lab reports, they'll be able to get rid of the wretched virus in a jiffy. Ditto anyone infected with AIDS and/or HIV.

How difficult can it be to make a gadget which will connect to the doctor and patient and indicate when there's some leakage?

Along the same line, this business of trying to promote condoms as a preventative for AIDS, as I think I've mentioned before, is not as safe as the condom manufacturers would like you to believe. The pores in condoms are much larger than the virus, so they act more as a strainer than a barrier.

Transplants

If you remember my reviewing *The Secret Life of Our Cells* by Robert Stone, you probably weren't surprised at the flurry of talk in the media about a new book claiming that transplanted organs bring along memories from the previous owners. NPR did a segment on it recently.

But this is just what I predicted in my review. My interest in this kind of weirdom started with *The Secret Life of Plants* by Bird and Tompkins, which was published in 1973. A couple of years ago I called Chris Bird to find out what new information had developed since the plants book was published. He suggested I get in touch with Cleve Backster, the chap who did most of the research reported in the book. So I called Cleve and found that his more recent work has been with human cells. The results have been incredible and are described in the Stone book. Both of these books are on my "books you're crazy if you don't read" list. Cleve and other researchers have shown

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Antenna Noise Bridge Detector

Tune your antenna, then measure its radiation pattern with this pocket-sized instrument.

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Salinas PR 00751

Using an antenna noise bridge is one of the best and simplest means of measuring antenna characteristics. It is invaluable for tuning an antenna, especially a beam, to resonance at a desired frequency. Normally the station receiver is used with the noise bridge as a detector to indicate the resonant frequency of the antenna, and the resistance and reactance (if any) at the feed point.

The feed point of most antennas, and practically all beams, is high in the air or at the top of a tower. It is extremely unhandy to carry the station receiver/transceiver up a ladder or tower, dragging a long extension cord. All this climbing increases the possibility of falling, which can be detrimental to yourself and whatever you are carrying. Of course, you could make your measurements on the ground, at the end of a multiple of half-wavelengths of transmission line, running up the tower to make an adjustment, then back down and into the shack to adjust the noise bridge and receiver. To make the job easier, I designed this simple-to-build instrument for you.

This detector, used in conjunction with your antenna noise bridge, substitutes for the station receiver. It even fits in your pocket so you can use both hands to climb to the feed point. Measurements at the feed point of your antenna are quick, easy and accurate. Even better, you probably already have the necessary parts in the junk box, so it can be constructed in an hour or two. Even if all parts must be purchased new or surplus, your total expense shouldn't exceed five dollars, not including the enclosure.

How it operates

The circuit is illustrated in **Fig. 1**. The noise output from your antenna noise bridge is applied through a coax jumper cable to J1, an SO-239. This noise, which usually will peak slightly below 1.0 volts, is broadband white noise and is fed through C1, a 100 pF capacitor, to a pair of small signal diodes connected as a rectifier/voltage doubler.

The rectified DC voltage, filtered by C3, a 0.1 μF disc capacitor, is then applied to the base of a small signal NPN transistor Q1, which serves as a meter amplifier. Meter M1 is a small surplus 200 μA meter. It monitors collector current through Q1.

The emitter of Q1 is connected to the wiper of GAIN potentiometer R2, which controls the emitter voltage between zero and about +1.5 VDC. On/Off switch S2 is mounted on the GAIN control which, in series with R3, forms a voltage divider across battery BT1, a 9-volt battery which powers this instrument. The GAIN control is wired so the wiper travels from the end of R3 to ground as the knob is rotated clockwise. This sets the emitter bias and the point at which Q1 will go into conduction as rectified noise voltage is applied to Q1 base.

The current drain from the battery is approximately 8 μA with no input, increasing to slightly over 200 μA with the meter at full scale. With such low current drain an alkaline battery should last for years, even if you forget to turn the instrument off!

Frequency coverage

This instrument covers the range from below 40 meters to above 10 meters in two bands: 40 and 30 meters; and 20-17-15-12-10 meters. Eighty and 160 meters were not included for two reasons. First, there are very few 80 and 160m beams. Second, eliminating these frequencies made band switching considerably simpler, and reduced the cost and complexity.

Bandswitch S1, an SPDT toggle or slide switch, selects the frequency range. The tuning capacitor C2 is a small 150 pF air variable, although one of the small variables with thin plastic sheets between the plates, such as used in many small portable radios, may be used instead. C2, in conjunction with inductances L1 or L2, allows peaking the

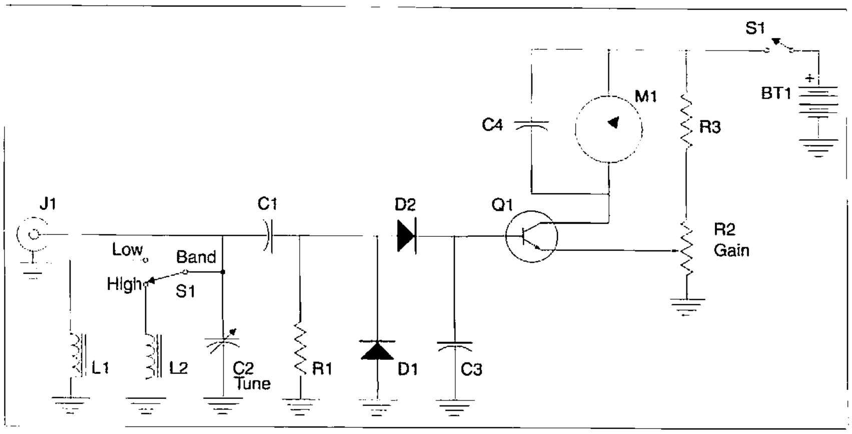

Fig. 1. Noise bridge detector schematic diagram.

frequency response of the instrument in the ham band in which your antenna is to be adjusted. Thus, it readily and handily substitutes for the station receiver, which otherwise would have to be used.

Construction

The detector should be constructed in an aluminum box, or an enclosure made of printed circuit board stock, because it must be well shielded to function accurately. Other than compact construction on a small piece of perf board, or a general-purpose printed circuit board such as are available at Radio Shack™, and short, direct leads carrying RF, parts placement is not important. Only those connections between C1, C2, L1, L2, R1, J1 and S1 carry RF. The other leads carry only DC, so their routing is unimportant.

Although any small 140-150 pF tuning capacitor can be used (take a look in your junk box), an APC type is recommended for compactness. This was a common WW II surplus item and can often be found at hamfest flea markets, or from Fair Radio Sales, Inc., Box 1104, Lima OH 45802. Small surplus meters with 100 or 200 µA movements, originally made for CB and home entertainment equipment, are also available from Fair Radio Sales and other mail order dealers as well as at hamfest flea markets. The toroid cores (T50-2) are available from Amidon Associates, Box 25867, Santa Ana CA 92799, and from Radio Shack. Other components may be found at numerous mail order parts dealers. However you probably can find just about everything you need in your junk box, from other local hams, or at the next hamfest you attend.

Calibration

There are several ways to calibrate this instrument. A source of low level RF covering the ham bands from 40 through 10 meters, with accurate frequency determination, is required. Your station receiver, or a frequency counter, can be used to check the frequency of a signal generator or a dip oscillator.

To calibrate with a dip oscillator, temporarily wind a two-turn loop around L1. Lightly couple the dip meter coil to the link, tuned to a ham band (40 or 30 meters). Be sure S1 is in the proper position. Tune C2 for a dip in the dip oscillator meter. Reduce coupling and tune C2 until the dip is just barely discernible. Mark this spot on the dial of C2. Using your station receiver to make certain the dip meter is on the right frequency will enable you to mark the edges of the wider bands on the dial.

Repeat this procedure with a link on L2 and S1 set for the high band. The 20, 15 and 10 meter bands are wide enough so you can mark both edges on the dial.

You can also use a signal generator to calibrate this instrument, using your station receiver to maintain frequency accuracy because signal generator dials are seldom very accurate. Connect the signal generator output, set for low level, to J1. With S1 set for the low band, tune C2 on this instrument for a peak on M1. Mark this point on the C2 dial. Repeat the process for each ham band.

You can also use your station equipment to calibrate this instrument by feeding your transmitter into a dummy load, or use very low power if you are feeding an antenna. Place a short piece of wire into the center terminal of J1 to act as an antenna. Key the transmitter on CW (key down) and tune C2 for a peak on M1. Mark this spot on the C2 dial.

Operation

This device can be used to replace the station receiver when adjusting an antenna. It can also be used as a linear field strength meter to measure the field around the antenna and plot its radiation pattern.

Operation as a noise bridge detector

Connect a short length of coaxial cable between J1 and the "receiver" connector on your antenna noise bridge. Connect the "unknown" connector on the bridge to the feed point of your antenna.

Tune the noise bridge detector to the ham band of interest. Then follow the directions in your antenna noise bridge manual and adjust your antenna, substituting the noise bridge detector wherever "receiver" is mentioned in the manual.

Measuring antenna radiation pattern

After you have adjusted your antenna you can use this instrument as a linear field strength meter. Connect a short antenna or a remote dipole to J1. With low power applied from your transmitter to your antenna, enough to register on the meter of this instrument, either rotate the beam to check its radiation pattern, or move the detector and its antenna around the antenna, noting the meter indications at each point. The distance between the station antenna and the detector or its remote antenna should be several wavelengths at the frequency in use for greatest accuracy.

When used to indicate field strength, the lower fifth of the meter scale will be nonlinear because of diode conduction knees. However, the upper 80% of the meter scale provides linear indications, so increases and decreases in the meter indication in this upper scale portion indicate equivalent changes in radiation intensity from your antenna.

Caution!

This instrument is extremely sensitive. It is easy to pin the meter when using it in conjunction with your antenna noise bridge, and also during the calibration procedure. Use the GAIN control as necessary to keep the meter needle from wrapping itself around the pin! 73

Parts List

BT1	9-Volt alkaline battery
C1	100 pF mica or poly capacitor
C2	140-150 pF variable capacitor (see text)
C3	0.1 µF disc capacitor
C4	0.01 µF disc capacitor
D1,D2	Germanium diode: 1N34, 1N60, 1N90, 1N270, etc.
J1	SO-239 UHF female connector (or builder's choice)
L1	33 turns #26 enam. wire on T50-2 toroid (40-30 meters)
L2	11 turns #26 enam. wire on T50-2 toroid (20 through 10 meters)
M1	100 or 200 µA meter (see text)
Q1	NPN small signal transistor: 2N2222, 2N3904, 2N4124, etc.
R1,R3	10k 5% 1/4 Watt resistor
R2	1000 Ohm linear taper potentiometer, with switch S2
S1	SPDT toggle or slide switch (Bandswitch)

Number 80 on your Feedback card

Carr's Corner

Analog-to-Digital (A/D) Converters

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Amateur radio astronomy has been a long-time favorite topic in this column. I've discussed the topic of frequencies from near-DC to daylight (literally!), but there always seems to be more to say. One constant question, however, is how can one collect the (essentially) analog data that results and store it in a computer? The answer is to use an analog-to-digital converter (ADC or A/D).

How the DC signal is derived

The receiver used for radio astronomy observations, whether VLF, HF, or VHF, will produce a varying signal level according to the strength of the received signal. It is that signal level variation that you want to record. This job requires that the signal be converted into a DC voltage; or, more correctly, a unidirectional varying signal that looks a lot like unstable DC.

This is done by using a rectifier and integrator circuit. Like most things, we can do this plain or fancy, depending on how you want it and what you want to do. **Fig. 1** shows the plain solution that I learned from Bob Sickles and Jeff Lichtman. It uses a plug (P1) to the speaker or headphones jack of the receiver. Once the receiver is tuned to the frequency being observed, the plug is inserted so that this circuit comes into play. The rectifiers consist of a half-wave voltage doubler made up of C1, D1 and D2; C2 is also part of the voltage doubler, but it serves a dual role as the integrator. Capacitor C1 can be a 1 µF tantalum, or some other form. If the capacitor is a polarized variety, then the polarity as shown should be observed. The diodes are plain vanilla 1N60 germanium diodes. These diodes are also sold by some dealers under the designations ECG-109 and NTE-109 (these are intended for the radio and television repair industry).

The integrator consists of C2 and R1. The time constant of the integration can be varied by changing the values of C2. I've used values from 10 µF to 470 µF with only a small observable change in the way it operates. The output signal is a DC voltage or current that goes to a meter, an oscilloscope, strip-chart recorder, or the input of an ADC.

The fancy approach is shown in **Fig. 2**. This circuit is a *mean value amplifier*, and is made from circuits seen in most good operational amplifier books, including my newly released (March 1996) title from Butterworth-Heinemann (313 Washington Street, Newton, MA 02158-1626; 1-617-928-2500). The book was released in England, but is available in the USA through the address shown. What is a mean value amplifier? Well, it's really just a rectifier/integrator writ large to justify using the op amps.

Amplifier A1 is a precise rectifier (half-wave), while A2 is a Miller integrator. The op amps can be CA-3140s (which use 741 pinouts), or a single CA-3240 (two 3140s in a single DIP with the pinouts of the popular LM-1458 device). The values of the resistors are not critical, but the ratios (R and 2R) should be followed. 5k ohm and 10k ohm, or 10k ohm and 20k ohm are likely candidates for value. The diodes are germanium 1N60s, although I've used silicon 1N4148 with no observable problems. The integrator time constant is R times the value of the capacitor. Start with 1 µF and work up 'til you get a good response. The compensation resistor between the (+) input of A1 and ground should have a value of R, or that input can be grounded if some small DC offset can be tolerated (try it first, however, because integrators like A2 don't like offset voltages at their inputs).

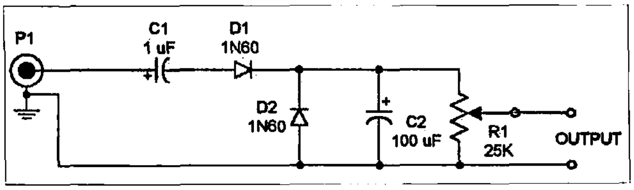

Fig. 1. Plain vanilla rectifier/integrator.

A/D converters

The job of the ADC is to take an analog input voltage and render it into a binary word that represents it. Cheapo converters that divide up the analog input voltage range into 256 states are available in 8-bit lengths A 12-bit converter costs a little more, but can divide up the analog voltage into 4,096 different values. In the 12-bit case, on an ADC that allows analog input voltages from 0 to 5 volts, 0 volts might be represented by binary 000000000000, while +5 volts would be represented by binary 111111111111. Actually, because of the 1-LSB and zero problem, the maximum input voltage would be only (4,095/4,096) x 5 volts, or 0.9998 x 5 volts = 4.999 volts.

One approach to the ADC problem is to build one yourself. The Maxim people seem to have a lot of really interesting circuits, one of which is their MAX-187 ADC. It comes in an 8-pin mini-DIP package, and offers 12-bit conversions and a serial output. The circuit of **Fig. 3** uses a MAX-187 and is connected to the computer via the parallel printer interface. The parallel printer interface is normally regarded as an output because it sends data to the printer, but there are five handshaking and signaling lines on the interface connector that either go back to the computer or are bidirectional. Wire the connector as shown, and then plug it into the printer output at the back of the computer. Make sure that the gender of the connector that you use is opposite that of the parallel printer output (otherwise, it's still a DB-25 connector).

You will have to write a short BASIC program to input the data. I have a candidate program, but it belongs to someone else. If you send me an SASE or reach me via E-mail, I'll tell you where to get the BASIC listing that runs this ADC.

The MAX-187 can be bought in single quantities from dealers such as Digi-Key (701 Brooks Avenue South, P.O. Box 677, Thief River Falls MN 56701-0677; 1-800-344-4539). By the way, if you're at all interested in electronic construction projects you need the Digi-Key catalog. It is chock full of neat parts; there's not a lot in the RF realm, but it offers nearly everything else (and they do have at least some RF parts). They are a source of the NE-602 chip used for a lot of direct-conversion radio receivers, for example.

Photo A. Pico Technology, Ltd ADC-16 serial port ADC.

Another solution is to buy a ready-made ADC from a commercial source. Several models are available that plug into either the parallel printer port or the RS-232 serial asynchronous communication port on the back of the computer. **Photo A** shows one that I bought from Pico Technology, Ltd. (Broadway House, 149-151 St. Neots Road, Hardwick, Cambridge CB3 7QJ, England). They take Visa cards, so you can order and not worry about sending a check (or as they say, "cheque") denominated in pounds sterling.

The version shown in **Photo A**, is the Pico ADC-16 model (although I understand a newer version is now out). It has eight software-selectable analog (or "analogue") inputs, resolution that is programmable between 8 and 16 bits, and a 12.5 volt input range. Pico Technology, Ltd. also offers two software programs for MS-DOS and Windows computers that allow you to run their various ADC products. PicoScope makes your computer work like a storage

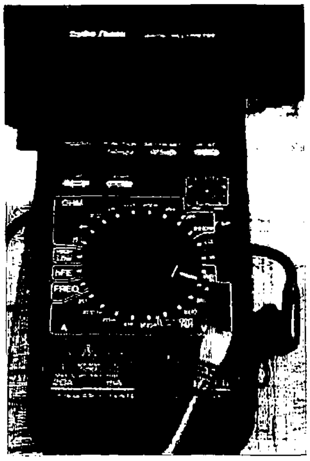

Photo B. Radio Shack computer-interface digital multimeter.

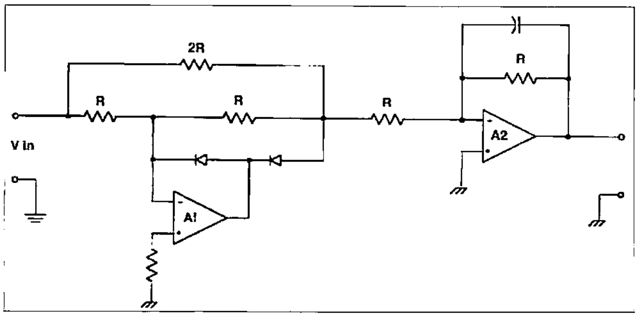

Fig. 2. Fancy rectifier/integrator (or "mean value amplifier").

oscilloscope when the ADC is connected, while PicoLog makes the computer into a nifty data logger. I use both software packages.

The final method, shown here in **Photo** B., is the Radio Shack™ digital multimeter that interfaces to IBM-PC compatible computers through the RS-232 serial port. The advantage of this device is that it also functions as a combination frequency counter (although not to a high frequency) and digital multimeter, when not being used for ADC. Also, because of the different ranges and functions, a wider range of parameters can be input to the computer. The Radio Shack instrument also comes with its own software for MS-DOS or Windows machines.

The Radio Shack computer-interface digital multimeter comes in a couple of different models. The one I bought is not easily found anymore; however, the manager of my local Radio Shack told me that he stocks a couple of varieties that replaced it. Check with a Radio Shack store to see whether or not this is a good idea for you. I paid around $130 for mine, but don't know what the current price is.

The use of the computer allows you to make a lot more observations, as well as do some neat data analysis that would be harder by hand. Strip-chart recordings look like "real science" but are a pain in the neck to read and use properly. I prefer the computer approach, if only for that reason.

Note: If you write a BASIC or Visual-BASIC program to read data from any sort of ADC, and want to time and date stamp the data using the computer's internal clock/calendar, then make sure that you store the data in a file in comma-delimited format. This means putting a comma "CHR$(0)" character between "print#" statements for the ADC data, time and date. If you do it right, then you can display the data through an Excel, Lotus 1-2-3, or other spreadsheet program. Also, the graphing functions of those programs can be used to plot your data if the ADC software lacks its own version.

Connections

I can be reached at P.O. Box 1099, Falls Church VA 22041, or via Internet E-mail at carrjj@aol.com. I welcome your input.

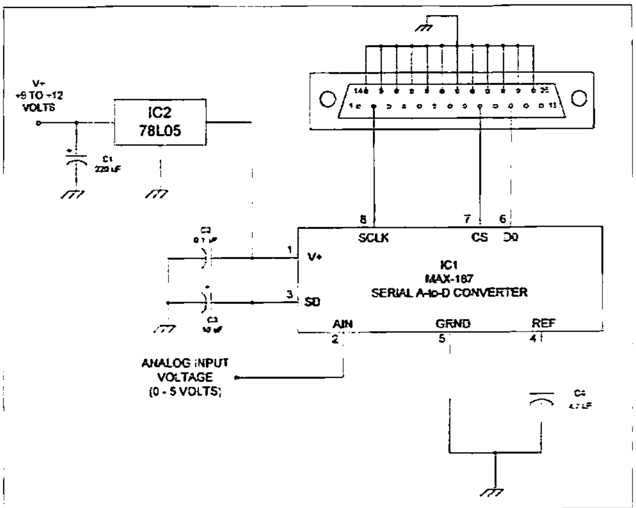

Fig. 3. MAX-187 ADC to plug into parallel port of a computer.

NEVER SAY DIE

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conclusively that all of our cells are in some way in communication with each other, no matter where they are. Which raises some interesting questions when it comes to organ transplants and blood transfusions.

It also ties in with the work of Antoine Béchamp (1812-1908), who opposed Pasteur's theory of microbes causing illness. You can read *Pasteur Exposed, the False Foundations of Modern Medicine* by Ethel Hume for the gory details of Pasteur's fakery. And the work of Royal Rife (1888-1971), as reported in *The Cancer Cure That Worked* by Barry Lynes. Rife's amazing microscope allowed him to see the most fundamental of life forms, just as Béchamp's had. And as Gaston Naessens (1924-) did with *his* super-powerful microscope. Naessens called these smallest of life forms somatids. And he found that they could survive freezing and 200°C. They were impervious to any acid, to nuclear radiation, and not even a diamond knife could cut them.

Béchamp was able to see them with his microscope by viewing cells using sunlight for illumination. This caused them to fluoresce and become visible. Rife did it by beating ultra-violet light against their UV light and viewing the mixing product of the two light frequencies.

Naessens found that when he injected the somatids from one rabbit into another he could make skin grafts to the second rabbit that would not be rejected. He tried this with humans and again there was no rejection. But the Canadian government and the medical association were so busy trying to put Naessens in prison for curing people of cancer (1989) that he couldn't get his research papers published. I reviewed the book, *The Persecution and Trial of Gaston Naessens*, by Chris Bird, some months ago. Of course it's on my recommended book list.

So much for transplanted organs staying in touch with the original owners, even after death. That brings up the question of memory, where very little research has been done. Somehow our cells seem to be able to contact our memories.

While most of us, when we are reborn, have our past lives erased from our memories, reincarnation investigators have found that many young children have memories of previous lives, but these fade away by the time they are around three. I've never had much problem helping almost anyone contact their past lives under hypnosis, often with great clarity. I found, as have many other therapists, that events in previous lives can sometimes have a considerable impact in one's current life. It would be interesting to regress someone with an organ transplant and see if there are contactable memories via the new organ. Ditto even blood transfusions.

The next step might be to develop people's ability to contact these memories. Might we eventually be able to give people transfusions of blood from hundreds of people with knowledge and skills in a wide variety of fields? How about becoming a concert pianist via a transfusion? Yes, I know, I'll probably get a bunch of letters from Techs asking where they can get some blood from a high speed CW op. Anything to keep from having to actually sit down and spend a few hours training their minds to get their hands to write letters when their ears hear the code sound patterns.

Walking out

Instead of telling me about your antenna and rig the next time we meet on the air, how about telling me about any outstandingly good movies you've seen recently? Sherry and I have walked out on two serious turkeys recently, despite one of them getting thumbs-up reviews and several OSCAR nominations.

You might also tell me what TV shows you find particularly interesting. I'd hate to be missing anything outstanding, which I doubt I am. Most of the stuff on TV is instantly forgettable and the time better spent contemplating one's navel. Or watching paint dry.

For a couple of seasons I really enjoyed "Picket Fences," but the writing took a serious nose dive this season. Something has gone terribly wrong there. Ditto "Roseanne," which used to have writing verging on genius. It's turned blah too. "Law and Order" has been

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NEVER SAY DIE

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continuing with its unpredictable plot twists, despite some cast changes. "Murphy Brown" started out pretty good, but ran out of steam a year ago. "Strange Luck" has been pretty good, but it's been canceled. Not much else I've checked out has. Oh, I enjoy Chief Inspector Morse in the "Mystery" series. And I save any magic specials that come along. Love those.

"Homicide" and "NYPD Blue" started off pretty well, but they got more and more wrapped up in developing the characters instead of the crime stories, turning them into soaps. The writing on "The Simpsons" is cleverer.

I save a lot of viewing time by taping everything first. I zip through the commercials, and ditto anything boring. I tape several of the magazine shows and zip most of them, slowing down for exposé segments. I prefer not to waste time gawking at OJ and the usual sob-sister fluff. News? If it's important it'll be covered in *Newsweek*. The rest of it is like gawking at road accidents.

I do most of my TV viewing while I'm eating meals, since I wouldn't be able to read or write then anyway. So my actual TV-only viewing time is minimal. Even so, it seems to be beating most of the movies I've gone to see. I guess my favorite for last year was "Babe." I'd rather spend more time reading, writing, and maybe even some time to get on the air.

Fluoride HI

My apologies for harping on this, but I just heard from one of your friends that despite my fluoride editorial last month you are still drinking city water. Do you really want to chance ending up as Alzheimer's veggies in a nursing home? Yes, Chicken Little is pecking at your door.

A reader sent me still another report on water fluoridation research. It turns out that even a small amount of fluoride in the water tends to leach out lead, copper and iron from water pipes, increasing their toxic effects. In fact, the total toxicity of the combinations is much greater than their sum. Sodium and aluminum fluoride cause irreversible memory loss, dyslexia, behavioral and learning problems. Just what your kids need. Of course we're solving that problem by sedating 'em with Ritalin.

Fluoride exposure during pregnancy retards brain development, lowering the child's IQ. That what you want?

My mother died of Alzheimer's, so perhaps I'm being over-protective of your health. I sure wish I'd known 30 years ago what I do now, but it never occurred to me that the government might do something so harmful to our health as this. Or that doctors, many of whom must have found out about this, would contribute to the conspiracy of silence. Up until I started reading about health care as part of my homework for the New Hampshire Economic Development Commission a few years ago, I believed in doctors, just as most of you do. I sure got a rude awakening.

If you run short of something to talk about on the air you might pass the word. And please keep your eyes peeled for any clippings I may have missed.

LETTERS

Continued from page 46

confident in saying I have similar opinions to many "no-code Techs." Since I am in amateur radio for fun, I refuse to be bullied into jumping through hoops to upgrade. I have no interest in Morse code. To steal a phrase from a soft drink commercial, "never had it, never will." It simply makes no sense to require code proficiency in operators who will never use it. I have no problem with operators who enjoy CW. That is what they like. I enjoy repeaters, FM, public service, and packet. I wouldn't expect anyone who had no interest in packet operations to demonstrate packet proficiency.

I would like to operate HF because I could pass traffic from other areas of the world experiencing disasters. This past hurricane season highlighted the need for services like this. Who gains when an eager operator is prohibited from performing public service work due to lack of code proficiency? How about the people in affected areas? This makes losers out of the amateur community as a whole. Public service is the strongest argument for amateur radio.

Escalating difficulty levels through the theory and practices sections of the test makes sense because we all use theory and we all had better know the rules. CW subbands are good because they give operators who enjoy CW a place to have fun. Let's face it, when it comes right down to it, code is being used to keep "the riffraff" out. If there is such a need, make the written tests harder. Keep it relevant. There is also probably an element of "I had to do it, why shouldn't you?" Ridiculous! Until we get past this absurd idea that proficiency in an antiquated form of communication must be a rite of passage, the lack of activity in the upper license classes will continue. Even the military has recognized the uselessness of code and phased it out. At one time CW had its place. In an era before the high quality electronics and alternate modes of today, CW may have been the only mode that could be pulled out of the noise. This no longer applies. Hams have always been progressive when it comes to equipment. Too bad we can't say the same about licensing. People in a hobby will do what is fun and forget the rest. When the ARRL realizes this I will upgrade, and probably not before.

Hey Mike, you troublemaker, you've got the germ of a really good idea there! Since the code is considered so important by the old-timers, not only should they be retested every year to make sure their code skills haven't deteriorated, they should also be forced to demonstrate packet, RTTY, and slow-scan skills...Wayne

Pete Sedler, Georgetown OH. Even though you've got an 84-page booklet of your as yet unpublished editorials, would you please discuss in *73* how to become an entrepreneur? I don't mean learning marketing, PR, budgeting, accounting, etc.; I mean how do you change from the employee mindset to the boss mindset? When I suggest to my always-broke fellow employees that they think of starting some kind of small business, they look at me as if I'd just beamed down from the mother ship. When I tell them I've started learning about the Internet in order to start a business, they edge away. They like to complain, but where has the old American pioneer spirit gone? An article in the paper said Baby Boomers are planning on using their paychecks from age 50 to 65 to finance their retirement, but with corporate downsizing, their careers will probably be over by the time they're 58.

Pete, if people were any good at planning ahead they wouldn't smoke, drink, get amalgam fillings, eat coffee and Danish for breakfast and burgers and fries for lunch...Wayne

Helen Clancy - XYL VK3DC. My husband David thrusts your wide-ranging and excellent editorials under my nose nearly every month. Your "Chef Green" November editorial prompted me to write. Indeed, you inherited a tasty coleslaw dressing from your grandmother. We tried it! But not simply on boring old cabbage. To the finely shredded cabbage we add shallots or spring onions, capsicum, green and red pepper, celery, and grated carrot. You can also add some diced apple, corn kernels, sultanas, cooked peas, pine nuts, and diced raw mushrooms. In our climate, four or five months of the year are salad delights. As you say, raw is healthy. And delicious. Keep the creative thoughts flowing. Oh yes, I love your contract.

You're right, Helen. I too enhance my coleslaw. The dressing also makes a marvelous dip for fresh veggies. I use it every day...Wayne

Bill Chatterly N1SGI. Since I'm a satisfied user of Computer Aided Technology's *Pocket Morse Trainer*, I was happy to see the ad for it in your magazine. I've passed my 5 and 13 wpm tests and expect to pass the 20 wpm test soon, but there's more. After seven months of use, the unit stopped working. I thought it might have been my fault, so I shipped it back, saying I'd pay the repair costs or the cost of a new Trainer, since I sure didn't want to be without it. Within 10 days I received a brand new Trainer...no fuss, no charge. My thanks to Computer Aided Technology. Thanks, also, to *73* for the many excellent articles you've published. I'm glad I subscribe.

Ed Fowler KC4RIY. I enjoy your magazine and your editorials. Your projects are great and do not have the voodoo that *QST* and *CQ* have. Keep it up.

Sure, Ed, but you can help. Whenever you run into anyone on the air who's built something that sounds interesting...like maybe an antenna that's working like gangbusters...get after him to write it up for us...Wayne

Tom McLaughlin, Mango FL. We are trying some of the remedies from your Nov. editorial and they seem to be working! My dentist, who is a very smart person and a stealth health nut, hasn't said anything about mercury fillings, but he has quietly been replacing my fillings with crowns. A recent article on ozone references gas vapors released during vehicle fueling. Maybe you've seen the very tiny federal warning stickers on gas pumps. If the truth was ever let out, I'm sure we'd see that Freon™ causes less than a hundredth of the ozone reduction that gas vapors cause. There is very little of anything in the air that matches the carcinogenic power of raw gas vapor, with its benzene and toluene components. Vehicle fueling should be done with vapor-tight fittings, like those used for propane. The cancer rate would probably start to go down immediately.

Another troublemaker...Wayne

Michael Smith WD4KMP/5. Two names stand out from my early years: Gernsback and Green. Thanks for four decades of entertainment and information. Three decades ago I developed painful ulcers. Gallons of Tagamet and such provided only temporary relief. But I got lucky...I contracted something much worse. After great quantities of various drugs I was "cured" and...surprise!...the ulcer was gone. This of course proves to me your idea of ulcer causation and cure. And reaffirms my "faith" in the AMA. Microbes, little critters which we can't see, right on down to viruses and even sub-viral "living molecules" cause us various cancers, rheumatoid arthritis, and a variety of illnesses. Internal medicine, as practiced today for profit, does just that: It generates more profit than health, just as you say.

The AEC said on TV recently that 3000 people die each year from cardio-pulmonary disease caused by burning fossil fuel. Disregarding their particular pecuniary interest in such stats, that's still not as dangerous as the cheeseburger and even less deadly than the automobile. But little is said of the things which cause 95% of us to die from other than old age because these things are not emotionally arousing. Is there a cure for *this* disease?

Wayne, you cost me $5 for the wonderful Roche tape, "The Fall of the Ivory Tower."

Ulcers? Lordy, read the $15 book, "Your Body's Many Cries for Water." A few glasses of water will quickly end ulcer pains. Are the millions of Alzheimer veggies ending up in nursing homes merely the product of years of dehydration? Mike, the "health industry" is just as crooked as all the other big businesses. I would be most interested to learn of any major industry that isn't crooked. Meanwhile, if any reader knows of a way to get people interested in living longer, please let me know. I've found almost everyone angrily resistant to any efforts to help them live longer and healthier... Wayne.

QSL Contest

Did you buy your QSL off a rack, or did you put some thought and creativity into it? If you think you have a winner, send it in and let us have a look at it. Who knows, it might make the cover. Well, maybe page 85 or so. Or maybe Wayne's wastebasket. If it's declared a winner, you'll get a CD of your choice of any of 26 kinds of music, as listed in Wayne's November editorial. You'll also see it in 73!

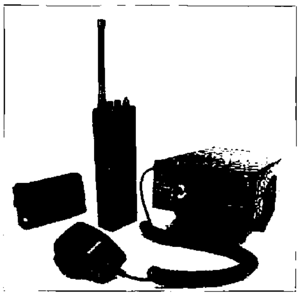
Send it to:

QSLContest,
73 Magazine,
70 N202,
Peterborough NH 03458-1107
Bribery? You Bet!

New Products

Continued from page 72

Presto-Change-O: New "Jerk and Run" Bendix King Radios



When you're in your car, it's a mobile unit with an RF amplifier, and when you leave your car behind, you take out the module and it's an HT.

That's the idea behind the new line of Bendix/King Jerk & Run radios. The ECH59 0JA and ECU49 0JA models include a 50-watt broadband amplifier. In addition to increasing the output of the units, the EC series allow any Bendix/King VHF or UHF portable radio to be inserted into a metal housing that charges the battery. The Jerk and Run feature allows the user to flip a lever and eject the radio with a spring-loaded mechanism and take the unit away for portable use.

BK Radio, Inc. can be reached at 2901 Lakeview Road, Suite 100, Lawrence KS. 66049. (913) 842-0402; fax (913) 841-0287.

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Manufacturers: If you have a new product and want it considered for review in 73, please call 603-9240058.

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

APR 28

BUDD LAKE, NJ The Northwest Jersey Hamfest will be held at the Budd Lake Firehouse, Route 46, rain or shine. Open at 6 AM to sellers; 8:30 AM to buyers. Talk-in on 146.520. Call *(201) 584-6550 days; (201) 770-0242 eves.*

MAY 4

CADILLAC, MI The Wexaukee ARC will hold their annual Hamfest 8 AM–2 PM at the Cadillac Middle School. VE Exams for all classes at 1 PM. Talk-in on 146.98 Rptr. Contact *Dan KE8KU, Wexaukee ARC, P.O. Box 163, Cadillac MI 49601. Tel. (616) 775-0998.*

FRESNO, CA The Fresno ARC, Inc. will hold its annual regional HamFest at the Riverland RV Park. Gates open at 7 AM and festivities last all day. Free camping Fri. night, May 3rd. For more info, listen to the Club's Sun. night Net at 7 PM on the Club's Rptr. at 146.940(-); or call *John Pritchett WA6JWK at (209) 222-6793.*

GREENVILLE, SC The 1996 Greenville Hamfest, sponsored by the Blue Ridge ARS, will be held 8 AM–5 PM at Anderson County Fairgrounds. Talk-in on 146.01/.61 or 146.22/82. Walk-in VE Exams at 12 noon. Contact *Jeff WA4EFT* or *Kay KE4NHX Borke* at *(864) 967-3284 after 6 PM, EST. E-mail: 102431.2306@compuserve.com; or mail to 403 Aster Dr., Simpsonville SC 29681.*

SIERRA VISTA, AZ The Cochise ARA Hamfest will be held at the club's site on Moson Rd., beginning at 7 AM. VE Exams on-site. Talk-in on 146.76(-). Contact John or Leatha Braden, 2200 Sonoita Dr., Sierra Vista AZ 85635. Tel. (520) 459-7960.

MAY 4–5

ABILENE, TX The Key City ARC, Inc., will host the ARRL West Texas Section Convention and the Key City ARC Hamfest. Setup for dealers and manufacturers will be Fri., May 3rd, 4 PM–9 PM. Set-up for all others, including dealers arriving late, will begin at 6 AM Sat. May 4th. Contact *Peg Richard KA4UPA, Hamfest Chairperson, Key City ARC, Inc., PO Box 2722, Abilene TX 79604. Tel. (915) 672-8889.*

MAY 5

BEMIDJI, MN The Paul Bunyan ARC will hold its annual Hamfest at the Northwest Tech. College, 8 AM–2 PM. Talk-in will be on the 146.73 Rptr. VE Exams. Flea Market. Contact Roben Beyer, *P.O. Box 524, Bemidji MN 56601. Tel. (218) 751-4801;* or *e-mail emilee@northernnet.com.* Individuals wishing to test must pre-reg. with *Gurnee Bridgeman, (218) 243-2002.*

DECATUR, IL The Richland Comm. College, Corner of Reas Bridge Rd. and Brush College Rd., will be the location for a Hamfest being sponsored by the Cenois ARC. Outdoor Flea Market open at 7 AM. New Vendor Area inside. VE Exams at 9 AM, walk-ins only. Talk-in on 146.730(-) PL 123.0; and 442.250(+) PL 123.0. Contact *Decatur Area Hamfest, P.O. Box 4595, Decatur IL 62525: or call Bert Ruble at* (217) 423-0314.

WRIGHTSTOWN, PA The 22nd Annual Hamfest of the Warminster ARC will be held at the Middletown Grange Fairgrounds, Penns Park Rd. starting at 7 AM. Setup at 6 AM. Computer hardware and software vendors are invited to participate. Talk-in on 147.69/.09 Rptr., and 146.52 simplex. VE Exams at 11 AM. Pre-reg. begins at 10:30 AM. Applicants bring original and one copy of present license and/or certificates of successful completion (if any): two forms of ID and the $6.05 exam fee (Novice class exams are free). Contact *George Brechmann N3HBT, at (215) 443-5656, 9 AM–9 PM.*

MAY 11

MANITOWOC, WI The Mancorad RC will hold their 1996 Hamfest and Computer Swapfest at Manitowoc County Expo Ctr. on County Hwy. R. Flea Market (amateur, computer, electronic). VE Exams (all classes) at Silver Lake College (Hwy. 151). Test reg. closes at 9 AM. Talk-in on 146.01/.61. Contact by sending an SASE to *Mancorad RC, P.O. Box 204, Manitowoc WI 54221-0204;* or call *Red (414) 684-9097 days; or Glenn (414) 684-7096 day or eve.*

MAY 17

SOUTHWEST OH The Southwest Ohio Chapter of the Quarter Century Wireless Assn. will hold its 1996 Annual Banquet in conjunction with the Dayton Hamvention on Fri., May 17th, at Alex's Continental Restaurant. C.O.D. bar at 7 PM; Banquet at 7:30 PM. Reservation deadline is May 15th. QCWA membership is not a requirement. Tickets $15 ea. Make check payable to *Robert L. Dingle, Treas. Chapter 9,* and mail to *1117 Big Hill Rd., Kettering OH 45429-1201.*

MAY 17–19

DAYTON, OH The 1996 Dayton Hamvention will be held at the Dayton Hara Arena and Exhibition Center. For Exhibit info, call *(513) 276-6931;* for Flea Market details, call *(513) 276-6932.* Talk-in on the DARA Rptr. 146.94(-), alternate 146.91(-). Dayton hams also monitor 223.94(-) and 442.1(+). Sponsored by the Dayton ARA, Inc.

MAY 18

EPHRATA, PA The Ephrata Area Rptr. Soc. will hold the 11th annual Hamfest starting at 8 AM at the Ephrata Sr. H.S., 803 Oak Blvd. VE Exams will be given. For info and table reservations, write *E.A.R.S., Inc., 906 Clearview Ave., Ephrata PA 17522,* or call *Bill N3PZA after 6 PM at (717) 484-2102.*

FORESTDALE, RI The Rhode Island Amateur FM Rptr. Service, Inc., will hold their Annual Spring Auction and Flea Market at the VFW Post 6342, Main St. The Flea Market opens at about 8 AM. An Auction will be held 11 AM–3 PM. Talk-in on 146.76. Contact *Rick Fairweather K1KYI, 144 Parkview Dr., Pawtucket RI 02861;* or call *(401) 725-7595 between 7 and 8 PM.*

MAY 18–19

YAKIMA, WA The ARRL Washington State Hamfest will be hosted by the Yakima ARC (W7AQ). Sat. May 18th, 9 AM–4 PM; Sun. May 19th, 9 AM–1 PM. Commercial dealers. Flea Market. VE Exams. Talk-in on 146.06/.66 PL 123. Contact *Larry Sieger KI7JL, 13112 Douglas Rd., Yakima WA 98908. Tel. (509) 966-5117 eves.* This event will be held at Selah Middle Sch., 411 N. 1st St., Selah WA.

MAY 19

SACRAMENTO, CA The North Hills RC will hold their Annual Radio Swap and Electronics Fair from 7AM–Noon at the Carmichael Elks Lodge, 5631 Cypress Ave. Carmichael CA. Talk-in on 145.190(-) and 224.400(-). Contact *Tim Lewis KD6FWD at (916) 722-7037;* or write to *NHRC SWAP, P.O. Box 41635, Sacramento CA 95841-0635.* Internet http://www.ns.net/~NHRC.

MAY 31–JUN 1

SO. SIOUX CITY, NE The ARRL Midwest Div., and the ARRL Dakota Div. will combine for the Midwest-Dakota-Hamboree Convention. The 3900 Club will host this event. A special luncheon aboard the Sioux City River Boat "Belle" is planned for the ladies on Sat., as well as other programs for XYLs. VE Exams. QCWA Luncheon and meeting. Wouff Hong ceremony. Flea Market. A Fri. night dinner has been arranged as a special fun night. Please request a flyer from *Dick Pitner WØFZO, 2931 Pierce St., Sioux City IA 51104.* The convention will be held at the Narina Inn on the Missouri River.

NASHVILLE, TN The Nashville ARC, Inc. will sponsor "Hamfest Nashville" on June1st at the Tennessee State Fairgrounds. Open to the public at 8 AM. Open to vendors from noon–11 PM Fri. May 31st; 5 AM–7 AM Sat., Jun. 1st. For table reservations, contact *David Scott KK4WZ, (615) 736-7855 days, or (615) 356-2929 eves.*

JUN 1

BANGOR, ME The Bangor Hamfest will be sponsored by the Pine State ARC at Hermon

H.S., 0800–1300 hrs. Flea Market. Dealers. VE Exams. Campgrounds and motels within 5 mi. Contact *Roger W. Dole, RR #2 Box 730, Bangor ME 04401. Tel. (207) 848-3846.*

LOVELAND, CO The Northern Colorado ARC will host "Superfest" 8 AM–3 PM at the Larimer County Fairgrounds, 700 S. Railroad Ave. VE Exams, commercial exhibits, computer and radio goodies, more. Reserve tables from *Jeanene Gage NØYHY, (303) 351-7327. Call Michael Robinson AAØUB at (970) 282-1167* for general info. Talk-in on 145.115(-), 100 Hz.

JUN 2

BUTLER, PA The 42nd Breezeshooters' Hamfest will be held 8 AM–4 PM on the Butler Farm Show grounds, just north of Butler PA. Talk-in on 147.96/.36. Dealers. Hamfest. For more info, call the *Breezeshooters' Hotline at (412) 854-5593.*

PRINCETON, IL The Starved Rock RC Hamfest will be held at Bureau County Fairgrounds beginning at 6 AM. Camping and outdoor Flea Market area is free. Talk-in on 146.355/.955. Contact *Bruce Burton KU9A*, or *Debbie Burton N9DRU. 1153 Union St., Marseilles IL 61341-1710. Tel. (815) 795-2201.*

SPECIAL EVENT STATIONS

MAY 3–5

GAY HEAD, MA The Fall River ARC will conduct their 3rd Annual DX-pedition at the historic Gay Head Cliffs; Martha's Vineyard Island. All HF bands, SSB, CW, 2m FM, 220 FM, 440 FM, and 421.25–439.25 MHz ATV. W1ACT/P will operate on IOTA freq. as NA-046. There will also be a MA QSO Party around 1.810, 1.850, 3.550, 3.890, 7.050, 7.290, 14.270, 21.390, and 28.390 MHz. QSL with SASE to *Roland Daignault, Jr. N1JOY, 19 Davis Rd., Westport MA 02790.*

MAY 4

ALEXANDRIA, VA The Mt. Vernon ARC will operate NJ4F May 4th to commemorate the 133rd Anniversary of the Civil War Battle of Chancellorsville. This will be from the site of "No Man's Land" on the original battlefield. Operation will be in the General portion of the 40 and 20 meter phone bands. CW contacts by request. For certificates, send QSL and large SASE to *MVARC, P.O. Box 7234, Alexandria VA 22307.*

GLEN BURNIE, MD The Bay Area ARS will operate W3QLP 1300 UTC–2000 UTC to commemorate the 152nd Anniversary of the telegraph message "What Hath God Wrought," transmitted on an experimental line from Washington DC to Baltimore MD. CW freqs.: 7.125, 14.125, 21.125 and 28.125 MHz. A 8.5" x 11" commemorative certificate will be offered. Send your QSL card or SWL description of the QSO, along with a large 8.5 x 11 SASE to *Hal Camlin W3QLP, The Bay Area ARS, 7506 Jacqwill Ct., Glen Burnie MD 21061*, for this special award.

MAY 4–5

DANBURY, CT The Connecticut QSO Party, sponsored by the Candlewood ARA, will be held 2000Z May 4th–2000Z May 5th, with a rest period 0400Z–1200Z. Phone, RTTY, and CW. Work stations once per band and mode, mobiles as they cross county lines. No repeater QSOs. Freq.: CW–40 kHz up from lower band edges; Novices 25 kHz up from low end. Phone–1.860, 3.915, 7.280, 14.280, 21.380, 28.380. VHF–50.150, 144.200, 146.580. RTTY–normal RTTY bands (no WARC bands). For more rules and details, contact *CARA, P.O. Box 3441, Danbury CT 06813-3441.*

WALL TOWNSHIP, NJ The Ocean-Monmouth ARC will operate KB2VPQ 1600Z May 4th–1600Z May 5th, to commemorate the Marconi Memorial Tower Site. CW will be up 10 kHz from bottom of Novice subbands, and 10.145, 14.045, 18.080 MHz, the bottom of General 8015, and Novice 10 meter Phone subbands. Send 9" x 12" SASE (or $1 U.S.) to *KB2SEO at his Callbook address*. Visitors welcome.

MAY 9

WEST MIFFLIN, PA The Belle Vernon H.S. ARC will operate KB3BKW from Kennywood Park on Amusement Park Physics Day. Novice 10m, General 15m and 20 meter phone bands. For a certificate, write to *BVAHS ARC, RD 2 Crest Ave., Belle Vernon PA 15012.*

MAY 10–19

HOLLAND, MI The Holland ARC K8DAA will operate to celebrate Tulip Time. Operation will be in the lower portion of the General 20 and 15 mete subbands, 28.400 MHz; and 146.52 simplex, all bands. for a certificate, send QSL with calls worked, and a 9" x 12" SASE to *Barbara Siebelink N8NXA, 6410 Otis Rd., Saugatuck MI 49453.*

MAY 11–12

FLOYD, VA The Foundation for Amateur Internat'l Radio Service will operate KK4WW, US5WE, BY1QH, 8R1WD and S21AM in their own countries to celebrate the 5th Anniversary of FAIRS. General portion of 40, 20, and 15 meters. For a certificate, send QSL and a 9" x 12" SASE to *FAIRS, P.O. Box 341, Floyd VA 24091.*

MAY 17–19

DAYTON, OH The Dayton AR Assn. will celebrate the 1996 Dayton Hamvention by operating W8B1/8 1200 UTC–2100 UTC May 17th; 1200 UTC–2100 UTC May 18th; and 1200 UTC–1600 UTC May 19th. Freq.: 25 kHz up from lower Gen./Nov. PH/CW band edges (op's choice). For a certificate, send SASE to *W8B1/8, P.O. Box 44, Dayton OH 45401-0044.* For more details call *Charlie KA8OQF at (513) 256-3783.*

MAY 18

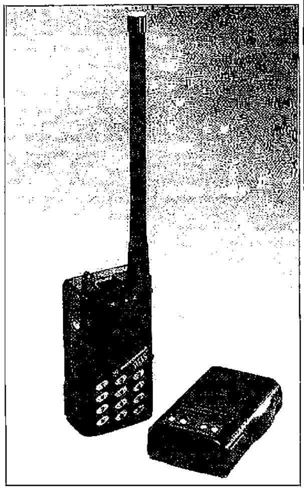
NEWPORT NEWS, VA The Peninsula ARC will operate W4MT 1500Z–2100Z at the parade site for the Centennial Celebration for the City of Newport News. Operation will be in the General 40, 20, 15m bands, and 145.23(-) Rptr. For a certificate and QSL, send a 9" x 11" SASE to *W4MT, 494 Pamela Dr., Newport News VA 23601.*

MAY 25

ASHTABULA, OH Members of the U.S. Power Squadron's Amateur Radio Net will operate from the Thomas Walters pilot house at The Great Lakes Marine and U.S. Coast Guard Museum from 1400 UTC–2200 UTC. Operations will be in the General portion of the 80, 40, 20 and 15 meter bands, in the Novice portions of 10 meters and on 2 meter simplex. Certificate for a confirming QSL card. Send SASE (for flat certificate send 9" x 12") to *Donald Stark N3HOW, 65 Stark Spur, Eighty Four PA 15330-9633.* 73

NEW PRODUCTS
Continued from page 83

VISAR Replacement Battery and Eliminator



Battery on that HT going dead in the middle of your first QSO after a night on the charger? W & W Associates has announced the addition of the VISAR replacement battery and eliminator to the extensive line of Two-Way batteries. The batteries are available in 7.5V @ 2000mAh and 7.5V @ 1200mAh.

W & W also now stocks batteries for the Yaesu FT-10R/40R, the Icom series IC-W31, IC-21A, IC-T22A, IC-T42A and Alinco DJ190/DJ-G5.

W & W can be reached at (516)942-0011 and is located at 800 South Broadway, Hicksville NY 11801-5017.

Number 86 on your Feedback card

The Tee Antenna

Short of room? This antenna may be just your size.

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

The low frequency bands are a bit of a problem for ham operators and shortwave listeners because longer antennas are required on those bands. For example, while a half wavelength dipole is only about 65 feet long on 40 meters and 126 feet long on 75/80 meters, you need 253 feet on 160 meters. Our SWL friends also have the same problem if they want to use a resonant antenna on the "tropical bands." Note: transmitters are more sensitive to the high VSWR that off-resonance antennas exhibit than receivers.

Real estate ain't getting any cheaper, so buying a 40-acre spread is probably not in most of our futures. *That* solution to the low frequency antenna problem is a non-starter.

One solution to the problem is the Tee-antenna shown in **Fig. 1.** This antenna uses two lengths of 300-ohm twin-lead to make a horizontal section ("A") and a vertical section ("B"). Note that this antenna looks superficially like a folded dipole, but it's: a) only about half as long as a folded dipole, and b) the conductors are continuous, rather than having the feedline drive the antenna in a balanced manner. This antenna is unbalanced.

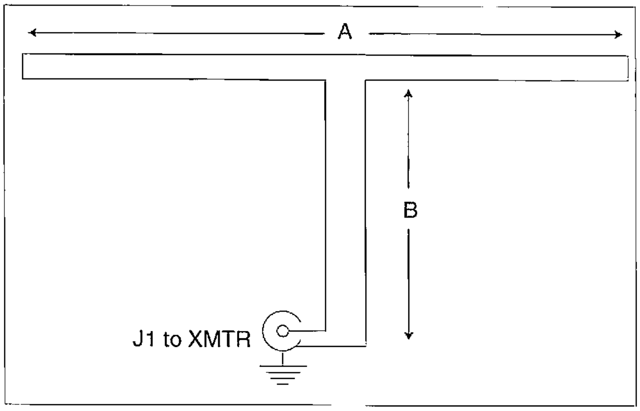


Fig. 1. While it looks *like a folded dipole, it's only about half as long!*

The horizontal section length (in feet) is found from:

$$A_{feet} = 270/F_{MHz} \quad (1)$$

While the vertical section is found from:

$$B_{feet} = 270V/F_{MHz} \quad (2)$$

Where: A and B are the lengths in feet, F_{MHz} is the frequency in megahertz, and V is the velocity factor of the twin-lead transmission line (typically 0.82 for television-antenna-style twin-lead).

Examples of the antenna lengths:

Frequency	A	B
7200 kHz	37.5'	30.75'
3750 kHz	72'	59'
1850 kHz	146'	120'

Win Fame and Fortune!

You can become world famous overnight just by getting an article published in *73*! Have you designed and build something hams would like to know about? Have you put together a kit which really deserves to be better known? Have you had an interesting ham adventure? How about a DXpedition? My answer to any of these questions you answer "no" to is why not? *W2NSD/1*

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

May is expected to be a decent DX month on good (G) days, but increasing thunderstorm activity may occasionally frustrate your weak-signal reception on the lower HF bands due to high static (QRN) levels. Expect the poorest (P or VP) conditions between the 5th and the 9th, and again between the 18th and 21st. The best days (G) are anticipated on the 1st and 2nd, 13th-15th, 23rd-25th, and 29th. The remaining days are either fair (F) or trending (F-P, P-F, F-G, and G-F as shown on the calendar).

MAY 1996						
SUN	MON	TUE	WED	THU	FRI	SAT
			1 G	2 G	3 F	4 F-P
5 P	6 P-VP	7 VP-P	8 P-F	9 F-G	10 G-F	11 F
12 F-G	13 G	14 G	15 G	16 G-F	17 F	18 F-P
19 P	20 P	21 P-F	22 F-G	23 G	24 G	25 G
26 G-F	27 F	28 F-G	29 G	30 G-F	31 F-G	

10-12 meters

This is a daylight-only band this month, but may present openings to tropical areas as well as short-skip openings on the best days (G). During intense, sporadic E conditions (rare this month) bursts of strong signals can come and go unexpectedly. Stay alert.

15-17 meters

These bands could stay open into early evening hours with possibilities of trans-equatorial DX on good (G) days and evenings. Signals seem to peak toward the west during afternoon and evening hours. Short-skip to 1,000 miles or so should be available on many days.

20 meters

This should be your main choice for DX-chasing. Because some areas of the world are dark and others are in daylight at the same time, you can expect dawn-to-dusk, and even later, DX opportunities on good (G) days/nights. Short-skip will prevail to about 2,000 during the day, and farther at night.

30-40 meters

You may find these bands quite noisy (QRN) during the daytime, due to the onset of thunderstorms this month, but they will be quieter during the nighttime hours. DX to your east will be the best before midnight, and best to your west before dawn. Choose good (G) days for best chances of scoring a new country. Short-skip of 100-1,000 miles during the day, and 500-2,000 miles or so at night will prevail.

80 meters

You may find that 80 meters will provide DX on good (G) nights, but it will be limited by thunderstorm activity. It may also provide short-skip openings of 200 miles or so during the day and 2,000 miles or more after dark.

160 meters

There will be *no* daytime openings here, due to a high absorption of signals, but it ought to provide skip to 1,000 miles or so after dark. Only rarely will you find DX, and only on good (G) nights with low or no thunderstorm activity. Low-frequency static bursts, hundreds of miles in length, limit your spring and summer operations.

The consensus among the forecasters is that Cycle 22 has reached bottom and will now start slowly upward. It was a short cycle indeed, about 10 years, and that's good news. See you on the bands. W1XU

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

Where 10m is shown, also check 12m. Where 15m is shown, check 17m too. Where 20m is shown, be sure to look at 17 as well. Always check the bands above and below the indicated bands for possible openings to the areas shown. Remember that DX is where you find it, and not always where it is predicted to be.

Number 89 on your Feedback card

UPDATES

In the March issue, page 77, column 2 paragraph 2 of "Never Say Die", the telephone number for the SETI project was given as 800-AU-SETI. The correct number is 1-800-TAU-SETI.

In the April issue, page 41, "The Alpha Delta DX-A 160-80-40 Meter Twin Sloper", the author's name was spelled John Stevenson. It is actually spelled John Stephenson.

Oops! In the April issue, page 33, "Alaskan Amateurs and Their Antennas", Photo B , you may have noticed the striking resemblance between Chuck K7JUT/KL7 in Fairbanks and Sarah Anderson W7KZE from page 31, Photo B, "Ham Radio and Summer School". That's because we accidentally printed Sarah's picture twice and left Chuck's out. Apologies all around! Here's the missing picture. Can you recognize Chuck?

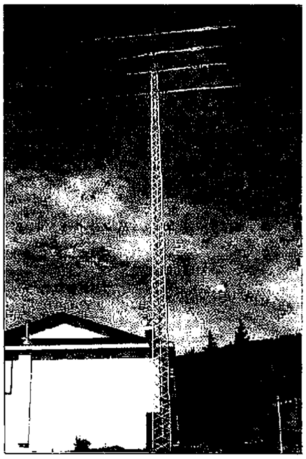


Photo B. Chuck K7JUT/KL7 in Fairbanks.

There are a few corrections in the article, "A Decibel Primer", by Steven R. Sampson, July 1995 issue, page 42. In the 7th paragraph "they need 80 dBm of amplification..." should read, "they need 80 dB of...". In the 8th paragraph also change "the waveguide shows a 1 dBm loss..." to, "the waveguide shows a 1 dB loss..,". Lastly, Mr. Sampson wishes to amend his definition of the word "bel"; "The main definition readers should be aware of, is that 10 dB = 1 bel; therefore, 1dB is 1/10 of a bel. That is, 1 dB is 1/10 of a bel (.1), 6 dB is 6/10 of a bel (.6), and 42 dB is 42/10 of a bel (4.2), etc.."

N2YMW's keyer in "An Inexpensive Morse Code Keyer" ,of the June '95 issue, starting on page 36, had some parts values wrong or left the parts off the list. The schematic, though, is okay.

Here are two equations that should have been part of WA9PYH's "Dish Antenna for Weather Satellite Images" in July 1995's issue: 13. f = D2/16d = 3600/16x8.835 = 25.47"; and 14. Compare to 16.63" + 8.835" = 25.465".

Also in July '95 in WA9PYH's second article, "A Low Noise Amplifier for 1691 MHz" there were errors. In Fig. 5 on page 24, the small holes should be 0.03" and not 0.30" and, in Fig. 6, the "7905 regulator" and all other "7905" should be "7805".

A correction from the Sultanate of Oman pointed out that in May of 1995, the QRX item "Long Walk" on page 8, we implied that Stefan Leca YO8RCW had a Oman license; he did not.

In the July '95 issue, the review "Maldol Antennas HS-2 and HS-75" gave inappropriate designations for the yagis, potentially causing confusion when trying to order either one of them from the dealer. The correct designation for the HS-2 is HSFOX2, and that of the HS-75 is HSFOX75.

The author of the June '95 "Super CW Station", pages 10-16, offered the pre-programmed 87C52 and the PC board for $40, and the convenience pack of all the parts for $85. Some generous readers have been sending $125. What N4UAU meant was that the whole works, including the board and 87C52 are $85, as long as he has parts available. "Stop sending too much money," he cries. Editor's note: if you build this, please keep notes and let us know how much fun you have with it so we can inveigle more readers into having a ball. Share your fun and excitement with a letter to the editor.

Number 88 on your Feedback card

HAM HELP

We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double spaced, on a full 8 1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully. A 1, for example, can be misread as the letters l, i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

Due to the Silent Key of W2KF, effective immediately, I have taken over the duties of QSL manager for Pedro Katz, HC1OT - HD1OT - HD9OT. Thanks in advance for your help in this matter. Ed Eklin KG8CY, 810 Harry Paul Dr., Lake Orion MI 48362.

WANTED: LCD display (LP156AE) for my ICOM IC 02AT handy. I also need diode D2 on the CPU initialization matrix. I will gladly pay for both. Thanks. Srikanth VU2GSM, PO Box 5053, Bangalore-560 001, India.

Including Ham Radio Fun!

JUNE 1996
ISSUE #429
USA $3.95
CANADA $4.95

International Edition

73 Amateur Radio Today

Did NASA Moon America?...

See page 88

Yukihiro, Son of JQ3JUG

Reviews: MFJ 9406 (6m SSB)
JPS ANC-4 (de-noiser)
GM-20 QRP Xcvr
Carolina Bug Katcher

Build: 2m Diamond ant.
NiCd Nurse
Henry Meter
Deluxe Foxhunting ant.

Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM or Mac formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

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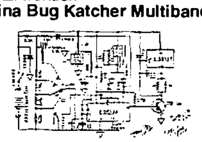
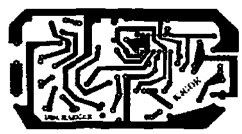


DEPARTMENTS



HAM RADIO FUN SECTION

On the cover: QSL Card Contest entry from JQ3JUG Tadatoshi Sakai of Shiga 523 Japan featured his attractive son , Yukihiro, hamming it up. Toshi, this is your "prize" cover photo. The 73 Team hopes you are pleased.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Contract: Even the most cursory glance at this text is sufficient to bind you, morally and legally, to take a kid (or kids) along on Field Day, get 'em fired up on amateur radio, and then help 'em get started toward a license. You'll feel good about yourself and our legal cousel won't have to hassle you.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Elect a Ham

Last month I proposed the first step toward the solution of a lot of our problems; that every ham club in the country make a major effort to get a local ham elected to their state legislature. We desperately need hams in high places to protect us. And not only will a bunch of hams in the state legislatures give us one heck of a louder voice with our states, but also with the Feds.

With the FCC (and Congress) wising up to how much money they can take in selling or leasing the spectrum to commercial users, they're looking for more to sell, and guess which group has the largest hunk of relatively unused microwave frequencies? We either start building some political clout or we'll be blown away.

We need state clout to stop the growing number of antenna-limiting laws and ordinances. But most of all, we need it to get our schools to start teaching electronics, communications and computers. This will get us more hams and help make it so America can compete better in the information age—the 21st century.

I was hoping the Dayton HamVention would allow me give a talk on this, but the ARRL apparently has them under such tight control that this wasn't possible, even considering the importance of the message.

As you read my editorial this month I think you'll see many opportunities where ham legislators could make a difference in education, health care, government, and so on.

If you have any say with the organizers of a hamfest or convention, and they're not totally controlled by the ARRL, maybe you can get me on the speaker's list. I'm not charging anything beyond the costs for Sherry and me being there, which is what any speaker normally gets covered. However, between demands for keynote talks at education, music, and science conferences, my available time is limited.

Your Government at Work

Last year one of those TV shows devoted to the weird did a show interviewing farmers and their children who were involved with that alleged 1947 UFO crash in New Mexico. They sure made a good case for the reality of a crashed UFO and its dead occupants being covered up by the government. It definitely was enough to cause any intelligent person to shake off the bindings of "conventional wisdom" and start looking for more information. Or should that be called "conventional ignorance?"

Of course, having always been interested in the UFO phenomenon, I've done a lot of homework. I've read dozens of books over the last 50 years or so, some very thoroughly researched, others a waste of time. I think I mentioned that back in 1963, Jay Stanton (darn, I forget his call!), a writer friend who was a total UFO skeptic, set off to expose the whole UFO business as bunk. About two years later, no longer a skeptic, his book telling about his conversion was published. He cited some most convincing cases.

I've read enough books, talked with enough people who have had personal experiences, and had enough experiences of my own to know that something real is happening. I also know from several incidents that our beloved government is up to here in a cover-up. Yeah, I know, the old government cover-up baloney.

Well, if I hadn't had a first-hand inside experience with the cover-up in the Amelia Earhart case, which is still being covered up, I might be less easily convinced.

Then, a few days ago, there was another TV weirdo show on the New Mexico UFO crash. This program interviewed the children of some of the Air Force people who were involved. They, like the farmers, had seen the ETs. And their parents, like the farmers, had been threatened by government agents to keep quiet. Or else. Again, their story was most compelling.

But a federal agency wouldn't threaten private citizens, would they? Well, they did *me*. One federal agency got me into a room and explained that if I ever wrote or even published anything about that agency again they would put me in prison and guaranteed I'd never get out. No, I have never written about them again. And I won't, except in my memoirs, where I will have a whole lot of interesting things to write about. But unless you start paying attention to nutrition, the chances are good I'm going to outlive you.

Green's Rocker

A book came a couple days ago from a reader who wanted to swap it for copies of some of my books. This one sure got my attention. I was busy trying to find out more about dowsing from a couple of new books I'd just bought, but this one made me put everything else down.

My first reaction was probably what yours will be. It's *NASA Mooned America!*, by René, 196p, 1994. The ridiculous claim is that the Apollo missions to the moon never actually happened. Oh, Lordy, give me a break! What is this, some Flat Earth Society-type crappola? However, not being completely controlled by what I have been conditioned to believe, I read on. René has done a masterful job of destroying what little faith I had left in NASA. He shows evidence that many of their photographs of the moon missions are clearly bogus; he proves beyond a reasonable doubt that nobody can survive in space beyond the protection of the Van Allen Belt; and so on. By the time he's through, there's just no doubt that our government has produced a $40 billion space opera for us.

Yes, of course, Wayne has gone off his rocker with this one. Sure. Okay, smarty, what's the temperature in space? Hot? Cold? We all know it's awfully cold, right? The fact is, when the sun is shining on anything it gets blistering hot. The surface of the moon is 243°F in the sun and -279°F for the two weeks of night. Our astronauts were just there in the daylight, so they were dealing with an environment that was around 250°, with nowhere near enough power to run the cooling system needed to deal with that. René goes into every aspect of the inability of any living thing to survive the solar flares that occurred during the missions with the little shielding used, the temperatures involved in space and on the moon. The astronauts reported that the LEM blasted a deep crater in landing on the moon. Why has not one NASA photo of the LEM on the moon ever shown a hint of this crater? They do show undisturbed dirt, complete with footprints (more about *that* impossibility later).

There are endless holes in the NASA production. Wait'll you see the not quite hidden power cords in some photos supposedly taken on the moon. Then there's one photo in the book of Aldrin and Armstrong saluting the flag, where they claim the sun is at about 13°, but Aldrin's photo was taken when the sun was at 26.4° and Armstrong's was taken with the sun at 34.9°, if one goes by the shadows they

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LETTERS

Number 6 on your Feedback card

From the Ham Shack

Matt Paulonis KA2OOX. Uncle Wayne, after being out of ham radio for a number of years, I recently decided to get back into the action. I have to give a special thanks to Bob Chamberlain N2KBC, of the Crystal Radio Club, for his encouragement. I walked into the VE examinations at WECA's hamfest at Yonkers Raceway, intending to sit for a Tech Plus License, but due to Bob's persistence, I walked out with a General! I guess I didn't know all that the knowledge was still up there. My first few hours of returning to amateur radio were looking good. I had yet to run into the type of ham you criticize in your editorials. Later that evening, after borrowing a 2m rig from my friend Ron Masters KO2L, I thought I would get a feel for my newly earned privileges. What better method is there to learn about the local scene than on one of the local repeaters? The radio I was using didn't have PL codes on it, so I was limited to open repeaters. On my drive back into Manhattan from my parents' house on Long Island I tried to reach a couple of repeaters, but could only raise one in Mineola. I announced "KA2OOX/AG listening" a few times on the chance that I could catch someone tuning around. As I was nearing the city limits and about to give up, I finally got a reply. I was excited at first, but then heard what he had to say. I don't remember his call, but he said that he was a part owner of the repeater, and that my announcing myself seven times was absolutely unnecessary. I wondered why, if he had heard me the whole time, and had understood that the ".../AG" at the end of my callsign meant that I was new at this, that he didn't he say, "hello," or something simple like "welcome," or even explain the rules governing "his" repeater. Maybe I was too optimistic to believe that you are wrong and that the majority of hams out there are friendly and willing to help. Now, Wayne, I can say that I can relate to your stories about "closed" or "private" repeaters. So ended my first day as a General. *(That's what I've been running into all around the country! Golly, I'm old enough to remember when amateur radio was considered a fraternity and friendliness was the rule, not the exception. You know, I don't recall seeing one blessed word about this problem in any of the stack of club newsletters I get every month... Wayne.)*

David O'Neil, Greenacres FL. Wayne, you started my publishing career with an article you printed in *Microcomputing* in June of '80. It was about the BASIC physics programs that I use in my class. I had a brandnew shiny SWTPC 6800 computer (kit) loaded with 16K RAM! Well, you let the genie out. I'm on the Internet now, and you are the first person I'm notifying about the address. I also subscribe to *Cold Fusion*, but the high-school engineering-and-science club I sponsor decided we wouldn't try that yet. We have done a one-person dry pedal submarine, ham TV, a TV-eye model car, a TV-eye rocket, a 10-gallon 3-tier beer microbrewery, a 3-axis flight simulation cockpit, and two radio-control lawn mowers. We designed a circuit that uses a TV camera and radio control to keep an R/C car with a light on it going in a straight line automatically. I hope you'll find the time to check us out at: http://www.webeom.com/sknkwrks/ *(Thanks Dave, for the note. I'll bet some of our teacher readers will be checking out your page. Meanwhile tsks and tuts for not getting the club to try a cold fusion project. They could make international fame! And, at this early stage of the game, maybe even get some patents. The world leader, as far as we know, is right over there in Sarasota... Wayne)*

Bill Parker W8DMR. My April article on debunking some myths about antennas, feedlines, and SWR calls for some clarification. Walt Maxwell W2DU has written with regard to vacuum-tube amplifiers, "Whatever the conditions of mismatch at the load end of a transmission line, a matching network properly adjusted to obtain a conjugate match at the line input reflects 100% of the reflected power." No damage occurs to the amplifier. Cecil Moore K67BK wrote to say with regard to solid-state amplifiers, "A reflected voltage wave, due to feeding a long unterminated transmission line, is in phase with the generated voltage." Due to excessive voltage, the solid-state amplifier will fail. Damage will occur. Both Walt and Cecil are correct. A vacuum-tube amplifier with a conjugate match system responds one way; a solid-state fixed 50 ohm output system responds another way. Comparing the two different types of amplifiers should have been included. Yes, even the debunker needs debunking occasionally. See how myths get started? It's easy.

Frank Rumph KD4DZI. Wayne, in the December issue there was an article, "Nostalgia for the Future," which called for 2000 ohm earphones. Since they're hard to find, I solved the problem by putting two 1000 ohm Radio Shack™ output transformers (#273-1380) in series and feeding the two 8 ohm outputs to the low impedance left and right stereo earphones.

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cast. Worse, the shadows are in two different directions, and the flag casts no shadow at all. The angles of the sun were calculated by the lengths of the shadows compared to the height of the men. The sun moves about 10° a day, so Aldrin's photo would have had to be taken a day after they claimed, and Armstrong's a day later, all followed by some computer trickery to combine them.

Or was all of this done in a secret Nevada CIA base?

René provides a book full of proof that the whole moon deal was a fake put together by NASA and the CIA. It's a very well-written and researched book. It reduces our Right Stuff heroes to mere actors who have gone along with a Hollywood-type production. And those who caused any problems were killed! Did the "accidents" which killed 11 astronauts in 1967 raise any questions in your mind?

Illusions

It's difficult for me to get used to the real world. It sure isn't anything like I was taught in school, or anything my parents led me to believe. The more I learn, the less I have to believe in. Politics is crooked clear through, with money, via lobbies, firmly in control. The medical industry is just as crooked, protecting its $1 trillion business with the cooperation of the government. Our legal system is seriously corrupt, as is our educational industry, again with the complicity of the government. Our academic system is corrupt, again in bed with our government. Should I mention our tobacco industry? And liquor industry? Our public water supplies, packed with chlorine and fluorides? Oh yes, our dental industry, with amalgams and root canals. Our food industry, providing us with hormones, pesticides, antibiotics, and de-mineralized produce.

So I suppose I am pretty dumb, or at least naïve, to be surprised to read an exposé showing NASA to be siphoning off billions to produce blockbuster entertainment epics, hand in hand with the CIA.

The worst part is that, even with our government and, as far as I know, every major industry, thoroughly corrupt, we seem to have the best country in the world. Maybe I should just shut up and go along to get along. Maybe I should go back to grumbling about the bad language, rudeness, and endless brain-free contacts on our ham bands. And fan the flames between no-coders and old-timers. The CW and phone ops. And any other ham schisms.

Say, those confounded packeteers aren't going to screw around with the Internet, are they?

Heck, if you get to know many of the ARRL directors beyond the thoroughly whitewashed meeting reports in *QST*, you'll find out in what contempt they hold the members. That really disillusioned me when I got on the inside and got to

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QRX . . .

Noteworthy hams

A list of "famous" hams was posted on the Internet. Do you know any famous hams not on this list? Let us know.

7L2NJY Dr. Mamoru Mohri, Japanese astronaut
9K2CS Prince Yousuf Al-Sabah
9N1MM Father Marshall Moran, missionary (SK)
A41AA Qaboos Bin Said Al-Said, Sultan of Oman
EAØJC Juan Carlos, King of Spain
FO5GJ Marlon Brando AKA Martin Brandeaux, actor
G2DQU Lord Rix (formerly Sir Brian), former actor and charity head
G3TZH Tony Dolby, brother of "the" Dolby
G3YLA Jim Bacon OBE, weatherman
GB1MIR Helen Sharman, astronaut
HS1A Bhumlphol Adulayadej, King of Thailand
I0FCG Francesco Cossiga, former President of Italy
JA5FHB Japanese Minister for Transport and Communications
JY1 King Hussein of Jordan
JY2 Queen Noor of Jordan
K0HWY Tex Beneke, band leader
K1OKI Mickey Schulhof, head of Sony US
K2HEP John Sculley, CEO of Apple (lapsed)
K2ORS Jean Shepard, author
K4LIB Arthur Godfrey, TV performer (SK)
K6DUE Roy Neal, television reporter
K7TA Clifford Stoll, author & scientist
K7UGA Senator (US) Barry Goldwater
KB2GSD Walter Cronkite, news reader
KB6LQR Jeana Yeager, Voyager '86 pilot
KB6LQS Dick Rutan, Voyager '86 pilot
KB6OLJ Paul J Cohen, mathematician
KC4OCA Gordon Barnes, weatherman
KD6OY Garry Shandling, comedian
KG7JF Jeff Duntemann, author
LU1SM Carlos Saul Menem, President of Argentina
N4KET David French, CNN newsman
N4RH Ralph Haller, FCC PRB chief
N5YYV Kathy Sullivan, Chief Scientist NOAA (former astronaut)
N6FUP Stu Cook, baseball player
NK7U Joe Rudi, baseball player
ON1AFD Count Dirk Frimouth, Belgian astronaut
S21A Head of Bangladeshi PTT
SU1VN/P Prince Talal of Saudi Arabia
SV2ASP/A Monk Apollo
U2MIR/UV3AM Musa Manarov, cosmonaut
VK2BL Graham Connelly, radio announcer
VK2DIK Dick Smith, entrepreneur & millionaire
VK2KB Sir Allan Fairhall, politician
VK2YOW Bob Hughes, radio announcer
VU2RG Rajiv Gandhi, Prime Minister of India (SK)
VU2SON Sonia Gandhi, XYL of VU2RG
WOORE Tony England, astronaut
W3ACE Armin Meyer, US Ambassador to Japan
W4ZG Worth Gruelle, started Raggedy Ann and Andy
W5LFL Owen Garriot, astronaut
W6EZV General Curtis LeMay (SK)
W6FZZ Samuel F.B. Morse III
W6JKV James Treybig, CEO of Tandem
W6QHS President of California Microware
W6QYI Cardinal Roger Mahony
W8JK John Kraus, astronomer
WA4CZD Chet Atkins, guitar player
WA4SIR Ron Parise, astronaut
WA6TJM President of ISD Inc.
WA7WYV Andy Griffith, actor
WB4KCG Ronnie Milsap, singer
WB6ACU Joe Walsh, singer
WB6RER Andy Devine, actor (SK)
WD4SKT Donny Osmond, entertainer
KD4WUJ Patty Loveless, singer
WP4CO Jose Feliciano, singer

New Zealand forcing CW to be dropped internationally?

At the last ITU WRC meeting (1995) an initiative was opened by the NZ delegation to visit this issue. The agenda Item was not pursued at that meeting, but will appear as part of a larger "look" at amateur radio at the 1999 WRC.

Many national societies are now examining this issue, including ARRL, RSGB, RAC, IARU, etc. IARU and ARRL have established working groups to prepare for WRC-99. You should contact your national society with your views and recommendations as early as possible.

Agenda item "2.2 Consideration of Article S25 concerning the amateur and amateur satellite services" for WRC-99.(Art. S25 renumbers previous Art. S32 which contained Radio Reg. 2375, amateur Morse tests for HF privileges internationally.) As result, the IARU has established a committee called The Future of the Amateur Service Committee (FASC) to assist/ advise the IARU in formulating policy/positions on the above WRC-99 agenda item.

The committee has a long list of matters on the agenda, and the committee is to encourage full discussion of these matters; invite comments from individuals, groups, member societies, and regional organizations; participate in meetings and take into account comments it receives; prepare reports, recommendations, and proposals by the Administrative Council, member societies and others.

As a first step, all IARU member societies have been invited to send opinions to the chairman of the FASC (VK3KI) as to "how the Radio Regulations might be modified or improved to meet the challenges of the 21st Century".

The first regional conference to consider recommendations from the committee will be the Region 1 Conference to be held in Israel, September 1996. Others will be held over the following two years leading to WRC-99.

In the UK, the Radiocommunications Agency has asked the Radio Society of Great Britain to consider formally the proposal to delete Morse testing as a requirement for HF privilege. "Whether the Morse test is a relevant means of differentiation (between classes of license)...It is clear that this is an issue on which there are differing and strongly held opinions. It is now timely to reconsider this issue and to decide whether the Morse requirement is one in which radio amateurs see relevance to the next millenium."

In France, F6IIE, vice-president of UFT (Union Francaise des Telegraphiste) has written, "Let those who are against the CW exam not delude themselves, they risk having something other than CW to learn. Those who are in trusteeship will not do away with (overnight) a 'filter' so efficient for controlling access lo the HF bands...the CW examination is not really so difficult...it opens up horizons certainly more interesting than all the data-processing systems (which are) useful indeed, but of which one tires so quickly, and which render communications more and more impersonal." (Translated from *La Pioche*, journal of UTF, by Ken Quigg GI4CRQ, and printed in *Morsum Magnificat*, Feb. '96.)

This will be a hot topic in the two and a half years before WRC-99. Be prepared to respond to surveys/ polls by ARRL and probably others, and to clearly express your reasons for retaining or dropping Morse as a requirement for HF operating privileges. Obviously the English and French are moving out smartly to face the issue, and do have opinions already in mind!

We are only a few months away from the first meeting at which the issue will be formally discussed in light of the WRC-99 agenda, so you might want to organize some thoughts carefully on the issue and maybe E-mail or post to the FASC committee member of your country, or nearest you.de AH6NB

Hams get help from Baker

Rep. Bill Baker (R-California) has introduced a bill to protect ham volunteers in the Volunteer Examination program and the Amateur Auxiliary of the FCC from frivolous lawsuits while they are doing their volunteer jobs. The bill, HR 3207, would afford amateurs engaged in statutorily defined activities with the VE program and with the Amateur Auxiliary the same liability as federal workers under the Federal Tort Claims Act. When individuals who fall under such protection are sued for something they have done while performing their duties, the Federal government steps in to protect them. Baker introduced the measure, the Amateur Radio Volunteer Services Act of 1996, March 29, 1996, as an amendment to the Communications Act. While the bill would not afford absolute blanket immunity, it does offer a fairly rigorous body of legal protection from the kind of malicious litigation that tends to frighten volunteers away from these activities, said ARRL Legislative and Public Affairs Manager Steve Mansfield, N1MZA.

Baker said that Amateur Radio volunteers provide an invaluable service to all ham radio operators by assisting in licensing and monitoring activities, thus saving taxpayer dollars. Those savings would dry up if volunteers stay away for fear of lawsuits, Baker said in a letter to colleagues. The bill is a simplified version of legislation originally introduced in the 103rd Congress by Rep. Jim Slattery. Individuals and private organizations currently protected by the Federal Tort Claims Act include Volunteers in Service to America (VISTA), the Peace Corps and the Job Corps.

Baker has enlisted members of both parties as original cosponsors of the bill. These include: Charles Wilson (D-TX); Bob Wise (D-WV); Edolphus Townes (D-NY); Mike Parker (R-MS); Toby Roth (R-WI); Charles Taylor (R-NC); Ron Dellums (D-CA); David Funderburk, K4TPJ, (R-NC); Ed Royce (R-CA); Norman Dicks (D-WA); Vern Ehlers (R-MI); Chris Cox (R-CA); Andrew Jacobs (D-IN); Harold Rogers (R-KY); Dennis Hastert (R-IL); Dave Weldon (R-FL); Anna Eshoo (D-CA); Ken Calvert (R-CA); Doug Bereuter (R-NE); Gene Green (D-TX); George E. Brown (D-CA); Eva Clayton (D-NC); and Sam Farr (D-CA).

Hams may want to write their own Congressional

Representatives urging them to support HR 3207. (From: *ARRL Bulletin* 19, 4/96.)

Harrisburg, PA, hams help in floods

About thirty volunteers from a Pennsylvania radio club came to the aid of the Red Cross to help after the Susquehanna River overflowed its banks, flooding the state capital on January 20th. According to John Obradovich W3IS, President of the Harrisburg Radio Amateur Club, hams provided communication between Dauphin County Red Cross headquarters and two mass-care facilities that lacked telephone service. The following day, the Red Cross requested additional volunteers with vehicles for disaster assessment training and reporting. Several hams were among those who reported.

No electronic renewal

The FCC will not renew your license electronically. So says the ARRL's Regulatory Information Branch in response to several recent queries. The League says that you can now download Form 610 from the FCC fax-on-demand service or from the FCC's home page on the World Wide Web.

The FCC now only renews a ham radio license if an application is received within 90 days before or two years after the expiration date. It will not be renewed if submitted earlier. And, if you apply for renewal after your license has expired, you may not operate until the application has been processed.

As announced last year, there is really no good reason for a person not to renew his or her license prior to expiration. Since last fall, the FCC has been sending out a mail-in reminder called Form 610-R. You should receive it at least 90 days before your ticket expires. If all of the information is correct, you just need to sign the form and return it. If for some reason you do not get a Form 610-R, a regular Form 610 is OK to use. From AMATEUR RADIO NEWSLINE

NEVER SAY DIE

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know all the players. Suddenly I found that the ARRL General Manager, the League counsel, and the directors all thought of the members as sheep, with no opinions worthy of consideration. It's the same arrogant attitude I see in most politicians.

Hey, if I suddenly "die" of a heart attack, I want you to know that my heart is in fine shape and that the CIA seems to leave a trail of heart attack victims who have caused trouble. Shades of the KGB! The Apollo mission data is still highly classified, so my reporting on the book may be endangering our country.

Exit Line

When this book arrived and I saw that it was an exposé of NASA, claiming that the moon flights were all faked, I expected to start reading the usual unsupported baloney like that which supports just about every claim I've read for zero-point energy, N-machines, and other mysterious new power sources. I was a 100% total believer in space flight. Oh, I didn't think the potential benefits of visiting Mars were worth the investment, considering the federal deficit, so I was glad to see that program canceled last year. Ditto the super collider.

But I've been a space fan since childhood. I got hooked early by a cartoon strip around 1929 called "Jack Swift." No relation to Tom Swift, though later in my childhood I enjoyed those books. Buck Rogers was there, but he didn't hold a candle to Jack Swift. Nor did Flash Gordon. Heck, the early Buck Rogers cartoons still had people using airplanes in the 25th century. Tsk.

So the whole idea that the Apollo flights had been no more real than the recent

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The Discharger

A NiCd nurse you really should build.

Marion D. Kitchens K4GOK
2709 Colt Run Road
Oakton VA 22124-1101

A battery *discharger*? Why would you want to discharge batteries? There are two reasons for discharging your NiCds. One is to measure the capacity of the battery pack to determine if it has exceeded its useful life. We all know that even NiCds have a finite life span, but we tend to assume they are good forever in everyday practice. Many NiCds are, however, rated for about 1,000 discharge-recharge cycles.

The other reason for discharging your NiCds is to recycle them to recover from "low energy memory." If NiCds are only partially discharged and then recharged repeatedly, they tend to "remember" this limited duty cycle and will not thereafter deliver their full rated capacity. They can often be recovered by a series of controlled discharges and recharges.

The Discharger was intended to help 4 to 12 NiCd cells, and allows measurement of the energy capacity of the pack. It can be used to determine when batteries are no longer useful, and as a test device to measure the useful life of a variety of different battery types. Knowing a battery pack's useful life or capacity can be a lifesaver in situations where battery discharge can result in damage or loss, such as in radio-controlled model airplanes. When used in recycling batteries, the Discharger will provide a measure of capacity for each discharge-recharge cycle to let the user determine whether or not progress is being made. The Discharger will automatically measure the time to discharge a battery pack so you can read it later at your convenience, thus eliminating the need to monitor the process in real time.

The Discharger is simple to build and to use. There are no critical adjustments or fussy circuits. All parts are readily available from a variety of sources. I have included a PCB layout, a Parts List, and parts placement drawings. Etched and drilled PCBs are available from FAR Circuits (18N 640 Field Court, Dundee IL 60118), or you can make your own. LED indicators show the state of circuit operation. You simply build it and use it, after checkout of course. Data measured on batteries at this QTH are provided for comparison with your batteries.

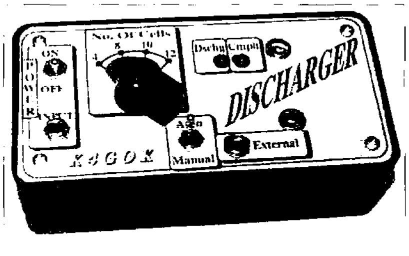

***Photo A.** The completed discharger (prototype unit).*

I you enjoy building and using simple "hassle savers," you will want to build the Discharger. It's a handy test device to have around your ham shack.

Theory

The purpose of the Discharger is to discharge your battery pack at a known current rate (200 mA in the design), and measure the time it takes to discharge the batteries. The time-current product is then a measure of your battery pack capacity in mA-hr. Discharge is to a voltage of 1.0 volts per cell in the pack. The Discharger circuit compares the battery pack voltage to a known voltage, and when the voltage is 1.0 volts per cell in the pack, the Discharger switches to an idle current (12-15 mA) and thereby terminates the discharge.

Fig. 1 shows a functional block diagram of the Discharger. The circuit is powered from the battery pack being discharged. A multi-position switch provides a voltage tap-off from the battery pack to the comparators, dependent on the number of cells in your battery pack. That voltage is compared to a stable 2.5

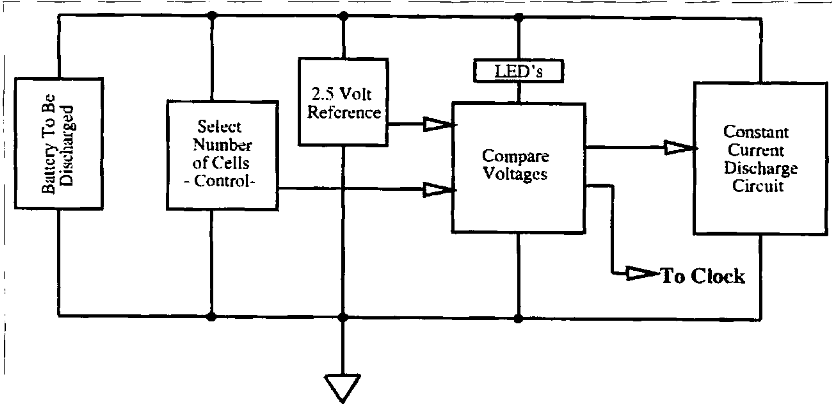

***Fig. 1.** Discharger block diagram.*

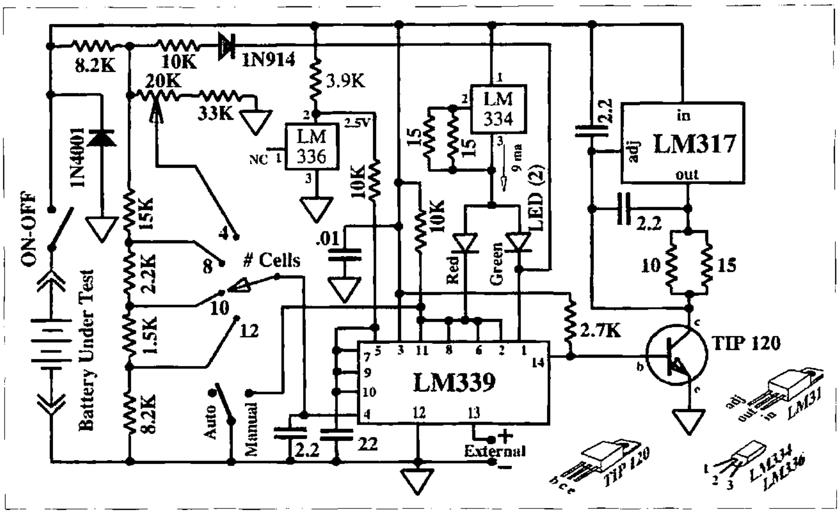

Fig. 2. Discharger schematic.

volt reference. As long as the voltage on each of the cells in your battery pack remains above 1.0 volts, the constant current discharge circuit is activated, as are the appropriate LED indicators.

Discharging to less than 1.0 volts is not recommended. For example, on a four-cell pack, the voltage would be 4.0 volts when the discharge is completed. When the battery pack voltage falls below 1.0 volts per cell, the discharge circuit is disabled and the circuit goes into an idle mode. To measure the discharge time, an external clock is also active as long as the discharge circuit is.

The discharge current of the Discharger is set at 200 mA, so a 400 mA-hr. battery pack should discharge in about two hours if it is at rated capacity. The external clock should then measure a discharge time of around two hours.

The complete schematic is shown in **Fig. 2.** A resistor divider string allows selection of the number of cells in your battery pack, thus providing a suitable voltage to the LM339 comparator. An LM336 2.5 volt reference provides the other input to the LM339 comparator. The remaining comparators of the LM339 are used as logic elements to operate the LEDs, the External control (clock), and the LM317 constant current part of the circuit. Note that the LM339 enables/disables the LM317 circuit by controlling the series TIP-120 transistor. The LM334 provides a constant current of about 9 mA for the LEDs, to prevent burnout with the wide range of voltages over which they have to operate.

Note that the 10k resistor in series with the 1N914 diode connected to pin 1 of the LM339 provides hysteresis to prevent the discharge circuit from re-energizing once the discharge cycle is completed. The Auto/Manual switch forces the LM339 logic into the discharge mode when in the Manual position, which is useful in certain situations, but not normally used. The 1N4001 diode across the battery input prevents reverse polarity from being applied to the circuit. An in-line fuse should be used so it will blow if the battery connections are accidentally reversed.

The only comparator actually being used as a simple comparator is the one with inputs on pins 4 and 5, and output at pin 2. The other comparators in the LM339 chip are being used as logic gates to control the rest of the circuit. The red LED is on as long as the battery pack is being discharged. It switches off and the green LED comes on when the discharge is complete.

Construction

The construction is rather straightforward using the PCB. The PCB foil pattern is shown in **Fig. 3**. Check out each portion of the circuit as it is constructed. The unit is designed to fit a 5-1/16" long, 2-5/8" wide, 1-5/8" deep experimenter box with a metal closure. Note that the usual thin sheet metal closure that comes with the experimenter box does not provide an adequate heat sink and should be replaced with a panel at least 1/16" thick. **Fig. 4** shows the drill pattern for the enclosure.

Study the schematic (**Fig. 2**) and the parts placement drawing (**Fig. 5**) before starting construction.

First, put in all the resistors, caps and diodes. Install the LM336 and LM334, and tack solder the LEDs in place. Check to make sure these are all installed with proper polarity; it's easy to install the LEDs wrong. The anodes of the LEDs should be connected to the two 15Ω resistors. Do not install the LM317, TIP-120 or LM339 yet. Use an in-line fuse of about 1 amp, and apply 5 VDC to the board. The fuse will blow if you connect the power with reverse polarity—that's what it's for. On 5 VDC, the current should be only about 1 mA. Check for proper voltages on the IC socket. Only pin 12 should be connected to ground. Pins 5, 7, 9, and 10 should be at 2.5 volts, and pins 2, 3, 6, 8, 11, and 14 should be at 5.0 volts.

Next, jump pin 2 to ground, and the red LED should light up. Jump pin 1 to ground and the green LED should come

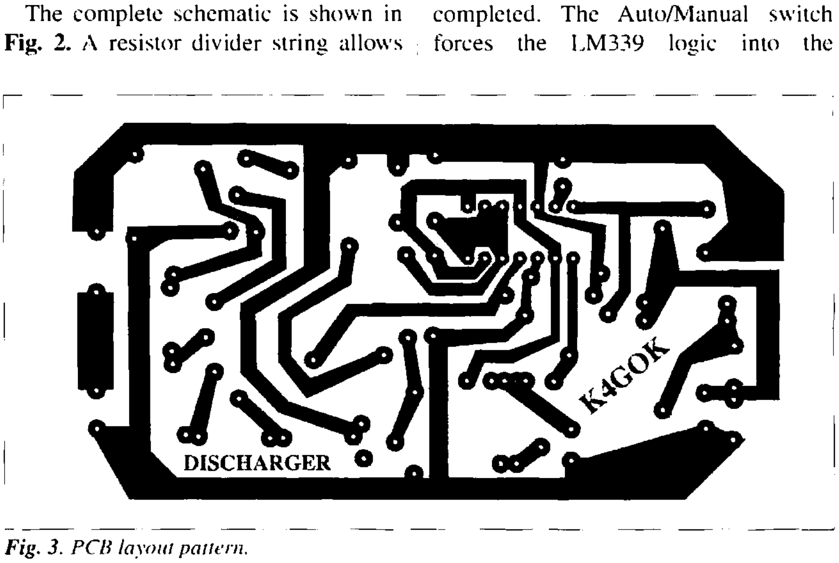

Fig. 3. PCB layout pattern.

NEVER SAY DIE

Continued from page 9

award-winning Apollo-13 movie was totally preposterous. But once I started reading I couldn't stop. Indisputable evidence piled up, fact after fact. As far as I know, no one who has read the book remains unconvinced that the world has been sucked in by one of the biggest snow jobs in history. If you read the book and aren't amazed at the enormousness of the deceit, and the success NASA and the CIA have had in keeping it secret, I sure want to hear from you.

Well, they did as good a job with secrecy on the Manhattan Project back 50-some years ago, so it's not without precedent.

And why didn't Russia blow the whistle, when they had to know early on that man would never survive in space beyond the Van Allen Belt without massive shielding against the intense radiation from solar flares? Read the book on our cost to bribe them.

Say, I wonder what else our beloved government has been doing that we haven't heard about? Let me know, okay?

Radio Bookshop

I've been going out of my way to avoid selling the books I've been recommending, knowing that some money-oriented readers would cry that I was "just trying to sell books." On the other hand, some of the books I've recommended are difficult to find, so I'll start adding some of them to the Radio Bookshop inventory. The Bookshop, which I started in 1958, has always been just a service, and never organized for a profit.

Anyway, if you're interested in having something really interesting to talk about on the air, I've arranged for Radio Bookshop to handle the NASA book. I don't think you're going to find it in any book stores. Send $25 plus $5 shipping/handling to Radio Bookshop, 70 North 202, Peterborough NH 03458. If you order any other books (like mine, for instance), the one shipping charge covers everything. Foreign orders will have to be more to cover the shipping. (See order form page 88.)

Instinct?

Now what in heck is instinct? European cuckoos, which are raised by birds of other species, migrate without guidance to precisely the spot in Africa where their parents migrated before them. Fish return to the streams where they hatched to spawn. Turtles find the exact same beaches where they were born. Monarch butterflies make one migration, from the Great Lakes region to specific butterfly trees in Mexico. The examples that "science" explains as instinct are endless. So, what's instinct?

What science can't explain it gives a name to and ignores or denies.

How do lost animals find their owners in places they've never been before? When a rat learns to navigate a maze, how can future unrelated generations be born with the knack for similar mazes? Is there a whole lot more to the adaptation of species than random Darwinian survival of the fittest?

If you decide to do some research along these lines you'll find organized science fighting you every inch of the way with ridicule, a refusal to publish your papers, and efforts to prevent any funding. Is it any wonder that our progress in non-accepted scientific fields has been so slow?

In the US I've seen the efforts of the Department of Energy scientists to make absolutely sure that if a new cold fusion industry develops, it will be in Japan, not here in America.

According to *The Skeptical Inquirer*, telepathy doesn't exist, yet almost every day I experience it with Sherry. She'll be driving along, with me in the back seat working, and I'll suddenly look up and remark on a sign or something unusual. Every time, it's something she's particularly noted and wanted to tell me about, but didn't want to interrupt my work.

I've reviewed books for you on how to communicate with plants and animals. Science is doing well with microcircuit development, but sure has a long way to go (with other scientists fighting every inch of the way) toward understanding psi, instinct, and other such phenomenon it doesn't understand and thus ignores or denies.

The comforting thought is that virtually every scientific belief (law) is eventually shown to be either untrue, or just partly true.

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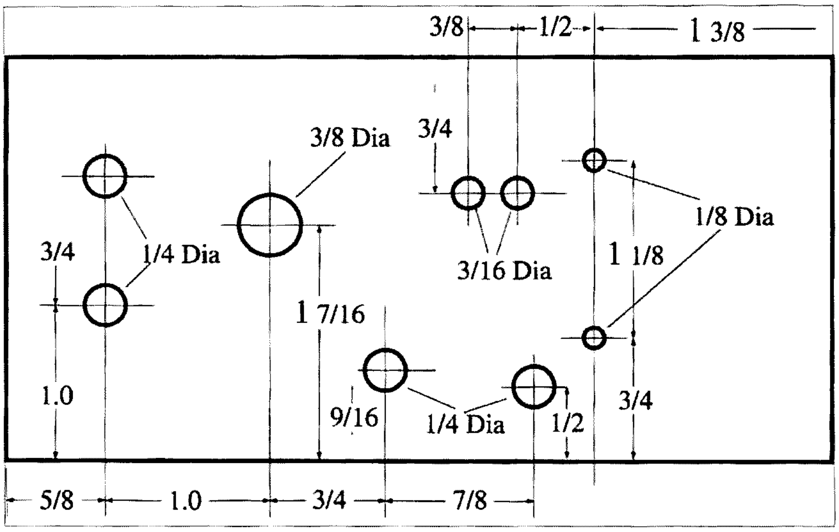

Fig. 4. Drill hole pattern for a 5" x 2.5" panel.

on. Connect the "Manual" (Auto/Manual switch) copper land to ground and the red LED should light up again. Remove the 5 VDC power before installing the LM339 in its socket, and check for proper orientation. Simulate the #4 Cell switch position by temporarily connecting pin 4 of the LM339 to the wiper of the 20k pot. Apply 5 VDC to the unit and the green light should flash briefly before the red light comes on. Current consumption should be 10 to 12 mA with the red LED on. Adjust the 20k pot for 3.08 volts on pin 4 of the LM339. You may want to refine this adjustment later. The control switches, LM317 and TIP-120, should be mounted next.

See **Fig. 6**, **Fig. 7**, and **Photo C** for the suggested method of doing this.

Note the orientation of the rotary switch, making sure the solder lugs are aligned with the PCB solder holes. Only four "positions" and the "pole" of the rotary switch are used. The switches and jacks should be mounted on the sheet metal closure, and short solid wires soldered to the pins as shown. The LM317 and TIP-120 should be mounted to the angle aluminum with insulators, as shown in the drawings. Be sure to use thermal compound when mounting the LM317 to the aluminum angle.

Next, bolt the aluminum angle to the closure, using thermal compound between the aluminum angle and the 1/16" thick closure. The assembled PCB should then be positioned over the solid wires and the LM317 and TIP-120 leads. Note that the circuit components are oriented toward the switches and closure. Make sure the ground lugs of the two jacks are connected to circuit ground, and the other lugs are connected to the positive battery input and to the output of the LM339 chip (pin 13). An error here will cause a short circuit!

Push the assembled PCB down until it is about 1 inch above the front metal panel (closure). Make sure it is square with the metal panel before soldering the connections. It is a bit of a chore to get all the wires in place, but be patient—the result is worth the effort. Now solder all the wire leads to the circuit board. You might want to adjust the length of the LED leads at this point for proper protrusion through the closure. **Photo D** shows the resulting components all mounted on the circuit board. The closure serves as the Discharger front panel (see **Photo E**). If you are not following the suggested construction technique, be sure to mount the LM317 on a suitable heat sink, and insulate it from ground. The TIP-120 needs to be insulated too, but since no heat-sinking is required it can be left free-standing on the PCB. **Photo F** shows WØDLQ's standard construction technique.

Continue the checkout as shown in the **Discharge Checkout Sequence** sidebar, using a variable voltage power supply to simulate the discharging battery pack. The supply should be rated at more than 200 mA, and capable of controlling the voltage to the indicated values accurately and easily. Conduct these tests in the sequence shown; otherwise the results can be confusing. When conducting the tests listed in this sidebar, you will note that the supply voltages for the switch between the red and green LEDs is different when the voltage is decreasing than when the voltage is increasing. That is because of the built-in hysteresis. It is the decreasing trip points that need to be accurate. That's what's happening as a battery is being discharged, of course, and that is what this circuit is for—discharging batteries.

As a final check, you could verify that the External connection goes to ground when the red LED is on. An LED with a current-limiting resistor makes a good indicator for that. Make sure the positive input goes to pin 13 of the LM339 chip, and ground goes to the Discharger ground. Limit the current into pin 13 to about 12-15 mA. The LM317 should not get hot on a 4 or 5 volt supply. You might want to check its temperature on higher battery voltages to verify that your heat sink is adequate.

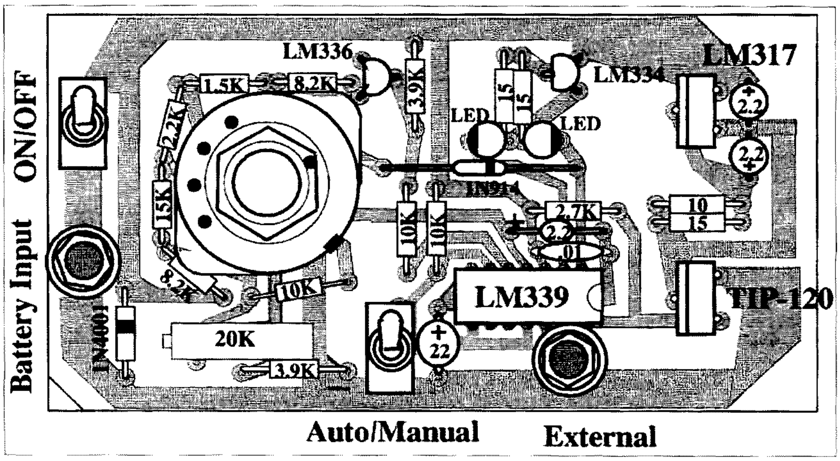

Fig. 5. Parts placement diagram.

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Epileptic Fits

Thank heavens for the fast-forward on my VCR remote! Well, with exposé TV programs on almost every night, there's always the chance that if I don't record them I'll miss finding out about another military-industrial complex boondoggle, another Congressional, medical, food stamp, welfare, and so on scam. The fast-forward button helps me avoid not only the commercials, but the wallowing in others' misfortunes, which the networks squeeze for every teardrop on these shows.

Did you catch the "Dateline" program with the exposé on the medical scandal over epilepsy? Any time you think that old Uncle Wayne is exaggerating about the mendacity of our so-called health care servers, who fight every low cost cure for a serious illness ferociously, all you have to do is a little reading. Like the *Racketeering In Medicine* book, which I recommended moons ago. Yes, it's on my list of books you're crazy if you don't read.

The program explained that around 70 years ago a very successful cure was found for epilepsy. But since it did not call for the use of any pharmaceuticals, the medical industry buried it. Except for one woman, who fought the medical bureaucracy for years, this cure would have been lost. Now kids with epilepsy can get this dietary treatment at Johns Hopkins, but only if they learn about it. Unfortunately, the AMA-FDA-NIH-WHO cartel has done a magnificent job of keeping most doctors unaware of this simple cure.

Maybe you saw the program about the Australian doctor who discovered an inexpensive quick cure for ulcers. The medical establishment fought him tooth and bloody nail for years before he finally won. I think it was the article about him in *The New Yorker* which finally blew off the lid. The medical journals, which play only the pharmaceutical company tunes, refused to publish his papers.

Let's Play Doctor

There's a new book (well, new to me) that'll be on the next expansion of my list of

recommended books. This is *Let's Play Doctor*, by Dr. Joel Wallach. He's the Nobel Laureate nominee who started out as a vet for around 17 years and then, as he puts it, got his license to kill, his MD.

I got introduced to Wallach by three different readers, who sent me tapes of a talk he gave called "Dead Doctors Don't Lie." I should put the tape on my book list; it's spectacularly interesting. So I sent for his book. Wow! I find I'm using it almost every day for reference. It's a large format book, 203p, 1995, $13 from Wellness Lifestyle, Box 1222, Bonita CA 91908.

Wallach points out that most of the illnesses from which people suffer also used to afflict animals and thus be costly to farmers. Simple, inexpensive cures for these illnesses were discovered years ago by veterinarians. Today, animals no longer suffer from arthritis, Alzheimer's, diabetes, heart trouble, and so on. Just the victims of our "health care" industry. Sorry, but the more I learn, the less I trust doctors, lawyers, politicians, and the chairmen of other major industries. Oh yes, and any government bureau...except, of course, the FCC.

The question arises...are you and all of your family in top-notch, fit and trim, robust health? If not, are you interested enough to learn more about your problems and maybe solve them? Probably not, if it means having to read some books. Right?

Healthy, Wealthy & Wise

How does that resonate with you? Well, in addition to my occasional grumbles about how we can make amateur radio more fun, I've been thinking and

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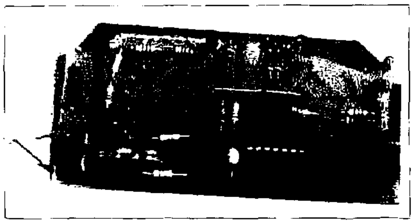

Photo B. Completed PCB assembly, without switches, etc.

Use a battery-operated mechanical clock so that it retains the display after power is turned off. The Discharger turns the clock power on when the battery pack is being discharged, and off when it is finished. Set the clock to 12:00 at the start of a run so that it will display the exact discharge time when the run ends. The connection at the External is an open collector NPN transistor inside the LM339. It can be used to operate a variety of things other than the clock, if desired. The transistor is rated at 15 mA and 35 V. **Photo G** shows the Discharger, battery, and clock ready for operation.

Operation

Connect your clock with its battery wire through the External jack as indicated in **Fig. 8.** Set the Auto/Manual switch to the Auto position, and the No. of Cells switch to the number of cells in your battery pack. For example, if your battery pack contains four cells, set the switch to position 4. Be sure to use a 1 amp fuse in the line between your battery and the Discharger, and plug your battery into the Input jack. Turn on the power switch, and check that the clock is running. Reversed polarity connections between the clock and the Discharger will cause the LEDs to blink on and off—make sure the polarity is correct and the clock is running. When the discharge is complete the red LED will go off, the green LED will come on, and the clock will stop. Record the time on the clock after discharge is completed. Multiply that by 200 mA and you will have the mA-hr capacity of the battery pack just tested. For example, if the clock reads one hour and 45 minutes, your battery pack has 350 mA-hr capacity.

To get a more precise measurement, you can measure the discharge current by putting a mA meter in the power leads when initiating the discharge—you should have recorded this value during checkout. This value will change very little as the battery is being discharged, and is reasonably independent of the battery pack voltage; therefore, it can be measured only once, and then that value can be used for all battery pack discharges.

To determine if your battery pack has exceeded its useful life, you will want to put it through several charge/discharge cycles. Start with a fully charged battery pack, and measure its discharge time. Make sure that the mA-hr measured is near the rated capacity of your battery pack. If it is, simply recharge the pack and put it to use. If the measured mA-hr capacity is not near the rated capacity, you will want to "recover" the battery pack. To do that, repeat the discharge/recharge cycle several times. After three charge/discharge cycles, the battery pack should show increased mA-hr capacity if it is still useful. Repeat the charge discharge process until the battery pack no longer increases its mA-hr capacity. Doing this a few times will make the user appreciate the Auto feature of the Discharger, because you don't have to monitor the process—just read the clock when it is convenient.

Proper operation of the Discharger assumes that all cells in the battery pack are good. A shorted cell will cause improper voltages and improper operation of the unit. You will normally want to start with a fully charged battery pack. Note that the Discharger will not operate properly on battery pack voltages below about 3.5 volts.

During normal operation the Auto/Manual switch should be in the Auto position. That allows the internal circuit to determine when the voltage on each cell in the battery pack has reached 1.0 volts, and shut down the 200 mA discharge current. If your battery pack has a number of cells not selectable from the No. of Cells switch, then you can use the Manual operating mode. In this mode, the discharge circuits are forced into 200 mA discharge current operation, independently of the battery pack voltage. Therefore, the operator will have to monitor the battery voltage manually to determine when the battery pack is discharged. Discharge of battery packs with more than 12 cells is not recommended because of the thermal load they impose on the LM317. The red and green LED indicators tell the operator what discharge mode the circuit is operating in. When the red LED is on, the battery pack is being discharged at 200 mA. When the green LED is on, the discharge is completed and the current has been reduced to about 10 mA.

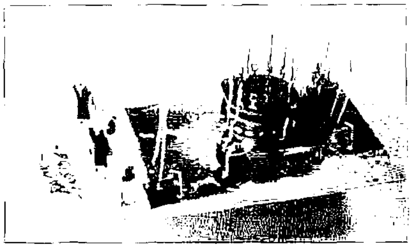

Photo C. Leads on switches, ready for PCB attachment.

Measured results

The results of measuring the capacity of a number of NiCd battery packs are shown in the **Battery Discharge Data** sidebar. Note the sometimes small, but notable, improvements achieved by the discharge/recharge cycling. Some battery packs (not shown in the charts) were found with quite weak cells and showed marked improvements via the cycling process. For comparison, the chart shows the mA-hr capacity measured for a fresh set of Alkaline AA cells.

Acknowledgment

The contributions of Gene WØDLQ played an important part in the design and refinement of the Discharger circuit.

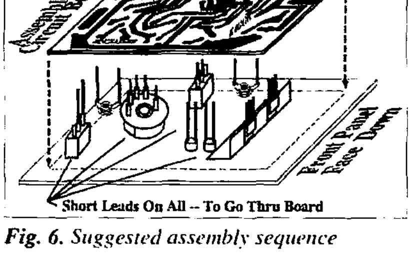

Fig. 6. Suggested assembly sequence

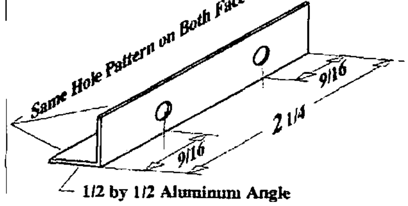

Fig. 7. L-mounting bracket.

NEVER SAY DIE
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writing a good deal about the HW&W aspects of life...much to the annoyance of monomaniacal hams. But the listener response to my appearance on the Art Bell (W6OBB) radio talk show was almost enough to get me thinking.

It was a three-hour interview and Art sells the tapes, if you're interested. It originally was broadcast on November 17th, and then rebroadcast on January 1. I talked a lot about amateur radio (of course) and a bunch of other things.

While my enthusiasm for amateur radio brought a few inquiries for more information, my discussion of health was the one that resonated the most and resulted in something over 2,000 letters. If you got a response like that to an interview it might almost make you think too.

Let me sum up my message. If you're interested in being healthy, wealthy, and wise, you have to start first with wisdom. And that means reading. If you read the right books you'll be healthy and wealthy. I'm convinced that you can, by making some nutritional changes, double your normal life span. And by knowing the well-kept secret to wealth, you can become a millionaire in five to seven years, starting from scratch.

The catch is simple. It's *change*, and most people would rather die (and will) than change their habits.

Health

Let me put this simply. After reading a lot and talking with some people I trust as experts, I'm convinced that when it comes to long-term illnesses, they're *all* the result of poor eating habits. And most, if not all, can be reversed by changing your diet. If you eat right and add the minerals and vitamins that are long gone from our industrially truck-farmed land, you're not going to have diabetes, arthritis, Alzheimer's, Parkinson's, heart attacks, brittle bones as you age, and so on. Worse, you can raise holy hell with the Social Security system by living to 120-150 years in good robust health.

I won't go into the details of what foods and additives you need in your diet, but I have a pretty good idea, and it includes changing your drinking water to eliminate chlorine and fluorides, as well as very small, but pervasive amounts of new chemicals. Maybe you read the article in the January 15th ('96) *The New Yorker* on the plummeting sperm count worldwide. I've been recommending this magazine for a long time for anyone interested in developing wisdom. Hey, you aren't born wise, you have to work diligently to build wisdom. The Good Lord wipes the RAM slate clean with each new incarnation.

Anyway, the article says, "But in this century we have generated all these new chemicals and injected them into the environment, and suddenly the body is exposed to new substances that in some cases can interact with hormone receptors. The human species is totally unprepared for this, because it has never happened before." For instance there's "Dioxin, which is a byproduct of chemical manufacturing and of the paper-and-pulp industry, which is present at low levels nearly everywhere in the environment, and can cause an astonishing amount of damage." The article goes on to explain that rats given a very small dose of Dioxin during pregnancy produced males with a 60% reduced sperm count. A widely used pesticide, vinclozolin, emasculated the male pups.

Organic farmers avoid the pesticides which are in our supermarket food, but their produce still doesn't have the minerals we need.

Look, our bodies adapted to the foods and waters in the environment over millions of years. Now, just in the last few decades, we've stopped getting the minerals and vitamins our bodies were designed to use. The result is a wide range of illnesses and a cutting of our life span in half. This also has affected our immune systems, making us much less resistant to passing bugs and infections.

There is also the impact of pain, both physical and mental, which lowers our immune system. But there are some ways to reduce this substantially, thus keeping the immune system strong. I'll have to write an instruction book on how anyone can do that. It's not difficult, but it's not presently accepted by the medical-industrial complex. Your doctor may be as kindly as mine, but he does not have your best interests at heart. The medical industry only makes money when you get sick, so they have a $1.4 trillion stake in your getting sick. If all they had to do was repair people damaged in

Continued on page 19

A much better-engineered design resulted from his contributions. All builders will thank Gene for building a unit in parallel with the original prototype, thereby providing necessary unit-to-unit variables and a more refined design.

My NiCds are now in better condition than ever before. The Discharger is easy to duplicate and can save considerable hassle with your NiCds. Building it is fun and the result is rewarding. Build one for yourself!

Photo D. Completed board with all the parts mounted.

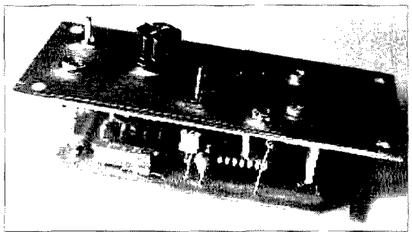

Photo E. The board mounted on the front panel, ready for paint and labeling.

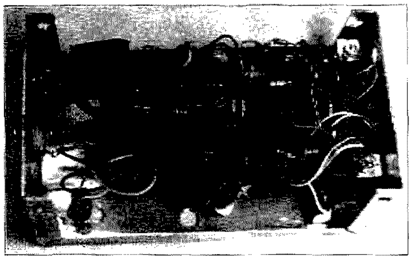

Photo F. WØDLQ's Discharger–standard construction technique.

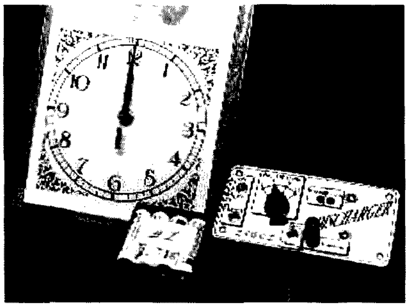

Photo G. The Discharger, with the clock, ready for operation.

Checkout Sequence

Conduct the following tests with a variable voltage supply in lieu of the battery pack.

1. Connect a 5 volt power supply to the battery connection points of the Discharger, observing proper polarity.
2. Set the Auto/Manual switch to the Auto position, and the # Cell switch to the #4 position.
3. When you turn on the power switch, you should see a very brief flash of the green LED, followed immediately by the red LED coming on and staying on.
4. If for some reason the red LED does not come on, put the switch momentarily in the Manual position, and then back to the Auto position.
5. Adjust the 20k pot for 3.08 volts on pin 4 of the LM339, with the red LED on.
6. Switch to #8 position, and the green LED should come on, and the voltage on pin 4 should drop noticeably.
7. Set the switch to #12 and the supply voltage to 15 volts, in that order.
8. If the red LED does not come on, switch momentarily to the Manual position, and then back to the Auto position.
9. Slowly decrease the supply voltage through 12 volts. The green LED should come on when the supply voltage is close to 12. Note that going up from below 12 volts will require higher voltage to get the red LED to come on. This is normal.
10. Switch to position #10, making sure the red LED comes on.
11. Slowly decrease the supply voltage through 10 volts. The green LED should come on when the voltage is close to 10.
12. Switch to #8 position, making sure the red LED comes on.
13. Slowly decrease the supply voltage through 8. The green LED should come on at 8 volts.
14. Recheck the #4 supply voltage operation to see if it has changed. If necessary, readjust the 20k pot so that the green LED switches on just as the voltage is decreased to 4 volts.
15. Measure and record the current drawn by the Discharger while the red LED is on. It should be near 200 mA.

Battery Discharge Data

Battery Pack	Size	Discharge #	mA-Hrs.
#1	AA	#1	171.1
		#2	391.1
		#3	389.2
		#4	398.2
#2	AA	#1	291.2
		#2	444.3
		#3	433.5
#3	C	#1	1053.4
		#2	1099.8
#4	AA	#1	347.3
		#2	462.1
Alkaline	AA	#1	1554.2

Parts List

Resistors (All 1/4 Watt)
10 ohm
15 ohm (3)
1.5k
2.2k
2.7k
3.9k
8.2k (2)
15k
10k (3)
33k
20k trimpot

Capacitors
22 µF
2.2 µF (3)
0.01 µF

LEDs (small)
1 red
1 green

Semiconductors
TIP 120
LM 317
LM 334
LM 336
LM 339
1N4001
1N914

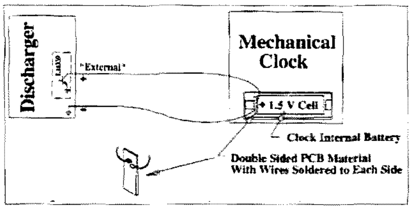

Fig. 8. Clock timer connections.

NEVER SAY DIE
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accidents, the industry would be more like a $500 million complex, with almost no pharmaceutical companies, and a tenth as many hospitals. Calling it a "health care" industry is as honest as calling the War Department the Department of Defense. Har-de-har. Let's really be nice and call it the Peace Department and have a Secretary of Peace.

Wealth

As with health, accruing wealth calls for a change in the life patterns which have been rather thoroughly ingrained. If you want to make more money than the lower middle class you are going to have to spend time doing the necessary homework. School? College? Forget it. Once you've learned to read, school is an enormous waste of time. Self-education is the key, and that means reading and asking questions.

If you have the guts to break your well-ingrained habits and start eating right, and learning, you can make all the money you want and have a darned good change to live to 150 in good health. Have you the willpower to not smoke that cigarette? To not swizzle another beer? To turn off the TV and read one of the books on my "You're Crazy if You Don't Read" list?

Have you ever bothered to read Napoleon Hill's *Think and Grow Rich* Pocket book? He first published it in 1937 and it's still in print. How about Parkinson's Laws? In Parkinson's *The Law and the Demand,* his Third Law points out that almost anyone can become a millionaire by the time they're 25 if they drop out of school at 15 and self-educate themselves from then on. That's the same thing I've been preaching.

The basic question is this: Are you a lemming or a pioneer? Getting a ham ticket shows a small sign of independence, so there may be an as yet unsmothered spark of guts somewhere within you. Our schools system and society in general put a heavy pressure on you to shut up and be a lemming. Don't make waves. If you ever work for a large corporation, any branch of the government, the military, or teach, you quickly find out how dangerous to your career wave-making and ideas can be. But in those directions lie enforced mediocrity and semi-poverty.

Our public school system was copied by our churches in the early 1800s from the Prussian model, which was designed to provide men for the Prussian army who would obey orders without question. The last thing the army or the church wanted to develop was a thinking population. Thinking equals trouble. The churches wanted unquestioning churchgoers and business needed people educated just enough to work in the factories of the industrial revolution.

The adventure of packet, ham satellite communications, the microwaves, foxhunting, and so on all provide an incentive to learn more about radio and electronics. Is it fear that's keeping you from exploring these new territories? Or stick-in-the-mudism? I'm always disappointed when giving talks at hamfests and I ask for a show of hands of those who are on packet. Those on RTTY? SSTV? Satellites? How many have worked more than 300 countries? How about going on a DXpedition?

No, they're on the local repeater. They call into a 75m net. 2m SSB? Nope. Meteor scatter DXing on 2m? Nope. Maybe some aurora contacts on 2? Okay, what do they know about M-PEG and compression algorithms? Why am I not seeing any hands?

Wisdom

How many people do you know who are really healthy? How many are wealthy? How many do you consider wise?

The response to my interview on the Art Bell talk radio show was encouraging and started me thinking about some sort of a newsletter or magazine devoted to helping people to make their lives better. But what could I do about procrastination? Most of us, even when we know what we're doing is destructive to our health or wealth, can't stop ourselves. Well, I'll eat this now and diet tomorrow. I'll watch the ball game today and exercise tomorrow. I'll put that new antenna up next week. Sure, I'd probably make more money if I'd read some books...and I will when I find time. Yes, I've been there and done that, so I know all about it personally.

As we get older and find our lives more and more restricted by the things we've done to our bodies, we finally start getting more interested in health. We start wanting to learn, at long last, about what food, water, air, exercise, sun, EMFs, poisons, and all that stuff we've pretty much ignored has done to us. And then, what the heck we can do about it now, if it isn't too late?

Some of us get angry when we find that the tobacco companies have knowingly been poisoning us. That the power companies have been doing ditto with their power lines. That the pharmaceutical companies, with the assistance of the FDA, NIH, WHO, AMA, and so on have been not only poisoning us, but doing their best to keep us from finding out how to be healthy. That scientists in general don't know what the heck they are talking about. And that our whole society is rigged to make sure that you don't ever make much money.

Do you think there is enough interest in breaking out of the all-pervasive, destructive pattern we've been living to support a newsletter? Probably not.

Skeptic

Now and then a book comes along that gets me all excited. "Wow!" stuff. Like the René book exposing the whole moon landing program as no more real than the "Apollo-13" movie. Which apparently was a documentary-type movie of a completely fictional event. The *NASA Mooned America* book will be on the next update of my list of

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Wheelchair Mobile

Dave Skinner KC5NLK operates from his wheelchair.

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Little Rock AR 72227

The CW class is about to begin when David KC5NLK and his dad, John KA5VAQ, arrive. David Skinner wheels into place, begins to set up his PC laptop, and prepares to copy code. After eight weeks of class he's confident he can nail down the 5 wpm exam. One week later he does, at the volunteer exam session.

Despite David's confinement to a wheelchair due to muscular dystrophy, he leads an active ham life. Dave can be found on the local repeaters, talking to some of his buddies. In addition, he works on a computer, using a specially designed mouse for input.

Photo A. Dave Skinner KC5NLK in his wheelchair mobile.

Because Dave did not want radio frequency (RF) hitting the back of his head and needed an antenna with some gain for use with his radio, His dad designed and built an antenna that uses an automobile up/down motor to raise and lower the whip. It enables Dave to use the higher gain antenna with higher power while keeping the RF well above his head. He can lower it to get through doorways and to miss those ceiling fans commonly used here in the South.

"Equipped with his laptop computer and VHF transceiver, David can be in either voice or digital communications from wherever he sits."

While on the subject of heat, only someone familiar with Arkansas summers knows the fierceness of the late June heat on the afternoon of Field Day. David was out there working the VHF station, chasing those contacts on an early evening E-skip. He also managed to enjoy the fellowship and traditional potluck dinner served by the Metropolitan Amateur Radio Club at its annual Field Day effort. David listened intently to the senior members of the Ozark Would Be Adventurers and Liars Club, who always meet on Saturday evening of Field Day. We now consider him a junior member along, with several of the other younger hams present.

He doesn't let his disability stand in his way. Dave has served as net control for the weekly Metropolitan Amateur Radio Club 2 meter net and participates in public service activities. He was recently elected Club Secretary for 1996. Aided by technology, Dave is able to contribute and participate with his fellow hams. He is currently working on upgrading to General Class.

He does seem like a young man in a hurry. If you don't believe it, just stand by while he zooms down the hall in his electric wheelchair mobile, living up to the tradition of teenage drivers. The batteries provide power for his chair motor, as well as for his on-board high-technology ham station.

Equipped with his laptop computer and VHF transceiver, David can be in either voice or digital communications from wherever he sits.

"He has been a real inspiration to other hams and a contributor to the club," said Kenneth Keplinger N5XLX, president of the Metropolitan Amateur Radio Club.

If you are passing through Little Rock, Arkansas, give a shout on the 146.07/67 WB5GFA repeater for KC5NLK. There's no telling where you'll find him in his mobile communications "shack."

NEVER SAY DIE

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"books you're crazy if you don't read."

As soon as I read that book I called René and asked what else he had. A few days later *The Last Skeptic of Science* arrived. It's another page-turner I couldn't put down. It's self-published, 179p, 1995, $25. As soon as I read it I faxed René to send me some copies to make available through Radio Bookshop.

Why did I get so excited? Well, René (nom de plume) fearlessly tackles Newton, Einstein, Hawking, Hubble, et al and wins. Do you really, honestly believe that the moon causes our tides? Or that there really have been ice ages? Or that there is a gravity force? Or that there ever was a Big Bang? Or black holes? An expanding universe? Or hundreds of fundamental particles? Or that the earth's magnetic field has reversed itself? Or that we have the field because the earth is a big magnet? Or that volcanos are caused by leaks from the earth's molten interior? Or that the transmutation of elements is either impossible or difficult? That the speed of light is constant? That objects of different weights drop at the same acceleration in a vacuum? Or that the ice cap over Antarctica is millions of years old?

René does a masterful job of tackling things scientists (he calls them science philosophers) and most of the rest of us have been taught to accept as facts and laws, reducing them to exploded theories. If you are a heavy believer in the authority of the scientific establishment this is a book you'd better not read, just as his moon book is best not read by people who are true believers in the honesty of our government.

For instance, when I got a call from Len WA2IHI about his efforts to help get the word around on the Beck blood purifier, I mentioned the NASA book to him and he got a big laugh out of it. April Fool, right? So I suggested he stop reacting for a moment and think. Remember the photos and movies of our astronauts walking on the moon and the footprints we could plainly see? Sure. Well, have you ever walked in hot, dry sand? You don't leave any footprints, just dents. It takes moisture to hold sand or dirt in place to leave a footprint and the moon's surface is about 250°F during the two-week day, so it is as dry as anything is ever going to get. It certainly is not going to register footprints. Unless moon dirt, unlike any other dirt, dust, or sand ever discovered, has some magical properties which bind it together, allowing individual grains to stick to each other.

Len squirmed and then said that obviously moon dirt is different. It holds footprints and tire tracks. Sure, and to hell with facts. I hung up, chuckling.

René cites dozens of solid reasons why nobody has yet been able to visit the moon. After reading this book you'll have something to talk about on the air besides all that money you put into your big antenna.

Both the NASA exposé and the Skeptic book are $25 (plus $3 s/h) from Radio Bookshop. I'll be surprised if you don't add both of these to your list of the most exciting books you've ever read.

René's ideas tie in with what I've learned recently from other books on my recommended list, such as *The Big Bang Never Happened*, by Eric Lerner, *Footprints of the Gods*, by Graham Hancock, and so on.

Maybe you've watched some of the recent TV exposés of the way the pharmaceutical companies, in conjunction with the AMA, FDA, NIH, WHO, and so on have covered up inexpensive and effective cures for ulcers and epilepsy. If so, you can understand why I'm reading every book I can find on alternatives to the current sickness repair system, and perhaps why I have less and less faith in authority figures. And that particularly holds for Ph.D.s and our beloved government. I suppose I should have been warned, since Ph.D. stands for a doctor of philosophy, not science.

Little that I was taught about science in high school and college has stood the test of time. I was taught that our solar system got started when another sun passed close to ours and sucked off the stuff making the planets. And my college physics classes never once mentioned quantum mechanics.

Say, I hope you are enjoying being with me on my adventure into learning about our universe, health, and so on. I've always found it exciting to learn new things, and I have this drive to share the things I enjoy with as many others as I can. Amateur radio has provided me with endless adventure as I've learned about one new mode after another. I've had a ball DXing, DXpeditioning, and contesting. I'm frustrated at failing to get our Techs to upgrade and experience the thrill of working a VK or ZL on 75m phone, or the fun of making contacts through our ham satellites.

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Upgrading Your Transmatch

Make your buddies sick with envy by adding a Ten-Tec tuning bridge.

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Much to Wayne's chagrin, any regular listener on the ham bands will find out in short order that the hot topic of conversation most evenings is equipment, and of all the equipment that hams love to talk about, antennas are number one. If you listen long enough you will also find out that there are really only two basic types of hams: those who buy the biggest, tallest, and most expensive antenna systems their spouses and their communities will allow and then talk about them incessantly; and those who don't, and talk about *that* incessantly. I fall into the latter group. There are a variety of reasons for this, not the least of which is that I'm a ham because I love to build things, and antennas are among the few pieces of gear that won't cost an arm and a leg to fool with. Besides, they can be as simple or as complex as your mother-in-law. In other words, any idiot can build one—even I can.

When I first began to experiment with odd bits of wire on slippery rooftops, I was fortunate enough to own one of those remarkable little radios from Japan that included, among other extraordinary features, a little bitty antenna tuner that would whir and growl and click its way to a perfect match between its transmission line and my rooftop creations. Alas, as the last sunspot peak began to wane I was forced back onto resonant antennas, first by the addition of a linear amplifier and second by trading up to a transceiver with a bit more basic receiver performance. I now drive a new American rig that doesn't have one of those fancy tuners. Oh well.

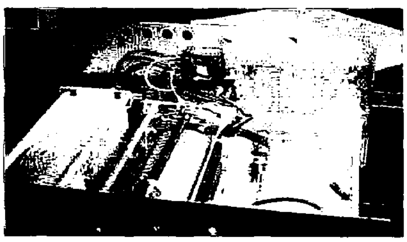

Photo A. Install the relay, RCA power jack, and a fuse on the back panel of the transmatch.

Clearly what was required here was an external transmatch of some sort so that I could deliver all those gobs of power to my loops and longwires and windoms. The big shock came when I began to price automatic antenna tuners for kilowatt stations. I hoped there was a less painful way...and there was.

Tuning a transmatch

I had known for some time that an ordinary noise bridge, of the type used to measure the impedance of an antenna circuit, could be used as an aid to tuning a transmatch. You will recall that these devices, available commercially and described numerous times in amateur publications, inject a noise signal into a bridge circuit comprised of an unknown antenna impedance and a variable capacitance in series with a variable resistance. While listening to the noise at the transceiver, you adjust the variable capacitor and resistor until a sharp null is obtained, then read the calibrated values of these components and modify the antenna to suit. If you substitute a 50 Ω resistor for the variable R/C devices and insert a transmatch in series with the unknown antenna impedance in this circuit you will have created a great aid to tuning a transmatch. Now you simply adjust the variable portion of the unknown arm of the bridge until the null is obtained. The transceiver will then be looking into a 50 Ω load.

All of this without emitting a lot of rude and offensive signal onto already crowded bands! This was important to me. With one or two possible exceptions, there is nothing quite so annoying as a tuner-upper doing his thing right in the middle of an ongoing QSO or net operation. Even more irksome, perhaps, is the knowledge that the guilty party has probably followed the old admonition to move a little off frequency to tune up; he's not going to be bothering his buddies a bit, but doesn't mind dumping a little QRM on the other guy as long as it's anonymous.

The Ten-Tec bridge

So along comes TKits, a division of Ten-Tec, with a new product line that serves up a simple circuit on a board, complete with parts for stuffing and an excellent instruction manual, at rock-bottom prices. I thought that their kit #1051, a "Transmatch Tuning Bridge," and my old Murch 1.5 kW "Ultimate Transmatch" ought to team up for the perfect "almost automatic" antenna tuner. They do, and it works terrific!

There's a phrase I first encountered in the works of Lewis Carroll that ring true for any project of this sort: "Begin at the beginning, then continue on until the end, then stop!" Having said that, however, there are a few words of caution and encouragement and some advice of a general sort that I'd like to impart by way of preparation for the journey. First, just about any antenna tuner would be suitable for this project, as long as there's some extra room to mount the circuit board and its interface to the tuner "under the hood." Secondly, if you're made like most of us you are probably a little uneasy about poking

Never Say Die
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Selenium

As I read the latest stack of club newsletters I kept seeing obits for local hams who have died of heart failure or stroke. Veterinarians solved that problem for animals decades ago. Farm animals don't die of heart attacks or strokes. Farmers add pellets with the minerals which are missing from today's crops to their animals' feed. But don't ask your doctor about preventative medicine, vitamins or minerals—they're not his field. If doctors were taught anything about health maintenance instead of just about repairs they wouldn't be dying an average of 17 years younger than the rest of us.

They're taught how to treat symptoms.

Cows, pigs and horses don't die of heart attacks or Alzheimer's because farmers give them the minerals they need with their feed. Well, that's something for you to think about as the ambulance rushes you to the emergency room. That old ounce of prevention. Or more likely, 50 mg of selenium or some other missing mineral that's critically important to your body's function.

No, I'm no MD, nor even a DVM, so I don't ask you to believe me. But I recommend that you do your homework the way I have. I realize that you may not have much time to read, what with your time on the air, a little time at work, watching ball games and sitcoms — all making you a living example of the boiled frog syndrome: If you drop a frog into boiling water, he'll jump right out. But if you put him in warm water with a fire under it he'll enjoy the warmth until he's boiled.

And that's the way it is with our smoking, using drugs, and eating food that lacks the basic minerals and vitamins our bodies developed dependencies on, over millennia of design. Our bodies were designed to work on raw wild foods. They were never designed to cope with coffee and doughnuts or Big Macs and fries. So, either we have to figure some way to get our bodies the materials they need, or settle for half a life. The expression "You are what you eat," is right.

The Silent Keys column doesn't explain what SK'd the recipient of this final ARRL Award, but club newsletters usually go into more detail. I'm still disappointed at reading about hams who have done much for the hobby only in club newsletter obits. What a shame!

For instance, in the "Badger State Smoke Signals" there was a very nice obit about Travis Baird W9VQD. Travis stroked out (a mineral lack). He was into music, opera, speed skating, photography, sailing, football, computers, the violin, ATV, and so on. Now he's gone.

Twenty of the 73 books on my list of "books you're crazy if you don't read" are health oriented. The most important is *Maximize Immunity* by Dr. Bruno Comby. I got a fax from him this morning saying he's planning on moving to the US to establish a healthy-living community. If you read *The Secrets of the Soil*, another of my recommended books, you'll find out how to grow food that has the missing minerals.

Ever since the invention of the flush toilet we've been getting rid of the minerals in our crops instead of refertilizing our fields with them, as people did up until this century. Now we use chemicals as fertilizer, and we're suffering the consequences.

Hmm, I wonder how many of you grew up in the country with a backhouse and had to shovel out the privy every spring? My family's farm in Bethlehem, NH, had no running water and no electricity, so I know what it is to take a flashlight out to the privy in back of the barn at night in the rain. And there was no heat until the first one up (me) started the fire in the kitchen stove with newspaper, kindling, and some kerosene to get the wood going fast. And another fire in the living room fireplace, when it was really cold. While the stove was warming up I'd refill the kerosene lamps. The stove had a water tank at one end, so once the water was warm enough I'd scoop some out into a five-gallon watering can. Then, in the summer kitchen, out by the woodpile, I'd hoist the can over my head with a pulley and take a fast shower. That part of the house was unheated by the stove, so five gallons of water was plenty.

America At War!

Short quiz: What is the most expensive war in American
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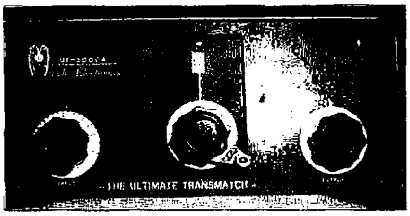

Photo B. Install the switch on the front panel.

holes in the front panel of a piece of factory-built gear. Don't be. There aren't many genuine collectors' items out there, and if you had one you would already know it. Besides, we are going to do an absolutely superb job of this and will actually increase the value of the piece. Finally, and this is very important, there is an even older saying that goes something like "One cannot make chicken soup out of chicken manure." We will need to be willing to acquire a few new tools if our finished project is to have the quality that we desire. See the sidebar.

The first thing I noticed as I unpacked the kit was that Ten-Tec had gone to great pains to provide decent documentation. Over the years I have assembled a number of projects that were hailed as marvelous in advertising copy, but proved to be largely design-and-build efforts when they hit the bench. Not so the TKit! The instruction manual reminded me a bit of the old Heathkit manuals: offset printed, well organized, and intended to be a permanent addition to the shack library. If I have any bone at all to pick with its authors, it's that they either failed to recognize or forgot to mention that the tuning bridge will not work if your receiver's noise blanker is engaged; its manufacturer actually intended it to be that way. Mash the old N.B. off button, however, and you'll have an abundance of noise that you can tune by. In any case, read the manual thoroughly and use the check-off format as you work through stuffing the board. Trust me–follow this advice and you'll have far less trouble to shoot later, and you'll have a more enjoyable experience to boot.

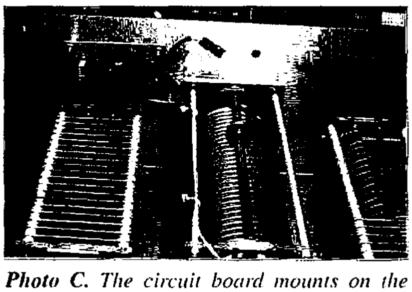

Photo C. The circuit board mounts on the back of the front panel.

Assembly

Before stuffing the board, you should lift the hood on the old transmatch and find out what kind of room we have for parts placement. This an important step, by the way, not only for this project but for any that you may take on. I've had a number of discouraging setbacks over the years when my impetuous nature urged me to leap forward before I'd even determined in which direction forward lay! Planning is more important to a satisfying outcome here than even the most perfectly soldered joint. We can easily re-solder a cold joint but it's always tougher to rip it all out and start over when we've made a haphazard start. In any case, start by taking stock of the total number of components and their possible locations within the unit.

You will have to decide whether to use a relay or a heavy duty switch to transfer between the tuning and transmitting functions. The decision was easy in my case; I already had the relay. Bear in mind, though, that using manual switching will require that you route high power RF to some point in the case where the switch can be located so as to allow easy manipulation of its handle. It's not as easy as it sounds, but it's certainly possible given some care in the routing of RG-8. Don't use RG-58 or other mini types in this application; they may not handle the high voltages typically found inside transmatches. On the other hand, use of a relay should allow placement of the transfer function directly adjacent to the input jack from the transmitter. The wiring diagram in the instruction manual illustrates the appropriate hookup. Use the normally closed contacts for the transmit mode and don't worry about the relay coming apart here; we are not switching RF, only transmitting when the contacts are at rest. By the way, you may want to avoid using a relay socket here. It will only add unnecessary cost and bulk in the installation. You can firmly attach the relay to the case with silicone adhesive and then solder directly to the pins (see **Photo A**).

While in the neighborhood of the back of the case, give some thought to how you will power the circuit board and the relay (if used). Though a 9 volt battery can certainly be used, most of us have a source of 13.8 volts around the shack with enough extra juice to power a project like this easily. I use RCA type jacks and plugs for low voltage DC at my station, with good results. Inexpensive audio cables are handy for feeders to various gear; just make sure that everything is plugged in properly before powering up, and that each source jack is adequately fused. In any case, drill a hole in the back panel of your tuner to accommodate whatever power jack you decide to use. Be careful not to drill into any components within; use a wood block if necessary to shield stuff from accidental puncture. It's amazing how deeply a 1/16th pilot bit can penetrate before either pain or dismay can persuade the brain that a pull-back response is in order.

"There is no surer way of letting the smoke out of one of these little ICs than sticking it in the holes with the notch at the wrong end."

Now that you have power it's time to locate and install the power switch. The switch I used is a two-pole unit so that I can energize the transfer relay and the circuit board with a single handle. It can be located at any convenient point on the front panel. Notice that most of these small switches have a tiny indexing groove on the barrel that is supposed to key into a tab protruding from the circumference of the hole cut to accept it. (What?) Never mind. I don't know anyone who has one of those punches. Just drill a tight round hole and use the hardware that came with the switch to make the most secure fit that you can. The object here is to keep the thing from spinning in its hole so that you don't know which way is on. A dab of silicone adhesive on either side of the switch body will keep things snug. Use great

Tool Acquisition Program for the Beginner

If you are reading this, you no doubt have acquired over the course of your life a conglomeration of tools with which you amaze everyone. You can perform such stunts as: extracting an errant toothpaste cap from the depths of a bathroom sink drain, replacing an electric light bulb from the front of an automobile, or inadvertently flipping the odd hamburger patty from the backyard grill into range of the family Rottweiler. These tools will not do. We will not be tightening screws here with a butter knife. If one truly aspires to be a genuine, true blue, Double Throwdown Electronical Wizard, then one must acquire a simple kit of quality tools. Rather than try to describe every item that should comprise this kit, I will profile a few that I have found helpful, if not essential, for a project of this type.

The first tool on my "must" list is always a decent multimeter. There is only one brand to buy, as far as I'm concerned, and that's Fluke. It's probably not kosher to plug a brand like this, and there are probably other good units out there, but that's my opinion and I'll stick to it. They are spendy when new, but are available reasonably on the used market. Try the back pages of *73* or *Ham Trader Yellow Sheets*.

Make something to hold the PC board still while you stuff it or solder components in. I knew a guy who didn't have one of these and he is now a Silent Key! Honestly, you cannot stay sane and complete a project like this without something that performs this function. Get a piece of 1/4-inch steel rod about 10 inches long. Bend a 90° turn about 2 inches from one end of it and jam the other end into a hole drilled in a block of wood. Use a hose clamp to fasten an ordinary spring clip to the end sticking up and you're done. These clips are called "Pony Clamps" and they are available in the woodworking section of large hardware stores. Send me $12 and I'll round this stuff up for you. If you feel like you just can't handle it, send me $32 and I'll send you the completed work clamp. Take heed, though, I'm making an enormous profit here, on something you could easily do yourself.

Ever notice how a drill bit worms around all over the face of your work before it decides to dig in and perform its function? Or after having drilled the holes for a row of indicator lights, you discover that they look like a tiny slalom course laid out on your panel front? The only way I know of to achieve acceptable results when fabricating the sheet metal for a project is to carefully, thoughtfully lay out each penetration, and then double-check each part for fit and clearance inside the case. Then get a spring-loaded center punch. To use one, place the hardened tip exactly where you are going to drill your hole and then press down firmly until the escapement mechanism lets go inside. *Voilà!* A perfectly centered punch mark to guide the pilot bit.

Now about those holes. Any hole drilled through a chassis starts life as a 1/16th-inch diameter pilot hole and increases size by stages until the proper fit is achieved. Take a look at **Photo E.** The two tools on the bottom are known as step bits and they are invaluable for rapidly producing just the right hole to suit the situation. After use, wrap them in a few turns of electrical tape so that they won't lose their edge rolling amongst all the detritus at the bottom of your tool box. The third device from the bottom is the aforementioned spring-loaded center punch. The tool on the top is a deburring tool, or a countersink. All right, as a countersink it leaves a little to be desired, but it does a whale of a job knocking down those razor-sharp little fuzzies that adhere to the edges of a freshly drilled hole.

Photo D. *The workbench, with a meter, soldering iron, center punch, an equipment clamp, and bits.*

Buy a decent soldering iron, or make a cheap temperature control unit for a cheap soldering iron by using an ordinary incandescent light dimmer. I bought my fancy Weller iron at an electronics surplus joint for $5. Get a coaxial cable stripper! Mine is made by Corex, has replaceable blades, and cost under $20. Get a set of those tiny little jewelers' files. If you do drill a hole slightly off-center, sometimes you can get things back in line with a little judicious filing. Wear safety glasses, please. I've taken metal particles in the eye twice in my life, and glass beads on one occasion. The glass bead incident occurred in spite of the use of glasses. Believe me, what they do to you down at the emergency room sucks all the way through to the end, not to mention the possible consequences to your vision if you're not as lucky as I was. Be safe and have fun.

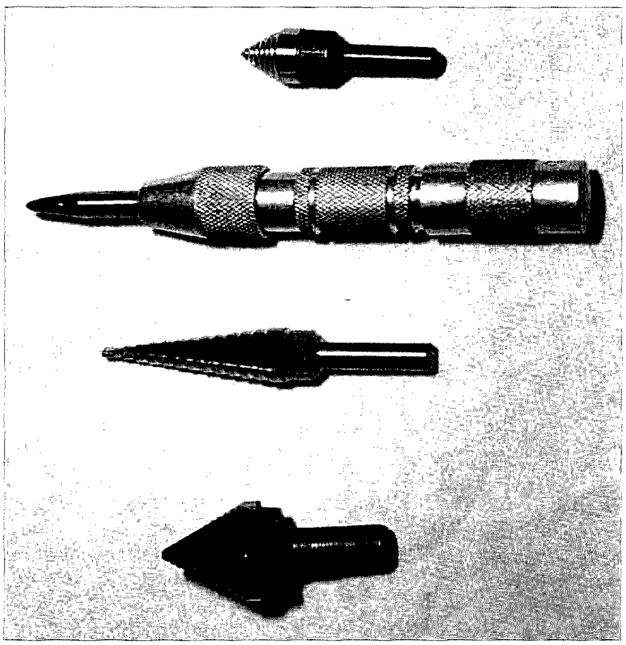

Photo E. *Center punch and three very handy drill bits.*

care tightening the front nut to avoid leaving nasty gouges in the panel face with your pliers (see **Photos B and C**).

Next, you have to decide where the circuit board goes. A nice trick is to use existing hardware, if that's possible. You may be able to fabricate a couple of small angle clips to allow attachment of the board to an existing component mount. Be aware that you must maintain clearance between live parts and grounded surfaces here. I used common standoffs, available at Radio Shack™, but have frequently used short pieces of plastic tubing, cut to length, with long screws to match. If you're fortunate, you will have enough room on the floor of the chassis or rear panel to mount the thing, and still route all the conductors that terminate there smoothly. Use some common sense, though. It is neither desirable nor necessary to make elaborate 90° turns everywhere, just to lead a few wires across the inside of a piece of gear. You will want to follow some sort of plan that keeps things together, takes advantage of a general structural element perhaps, or uses those little stickyback pad eyes to tie things down with wire wraps. Should you choose to install the board against the backside of the front panel like I did, there is a bonus possibility that you can mount the circuit's LED indicator directly to the circuit board (see **Photo C**). If you do, just make sure that you lay out the mounting holes and the LED hole using the board as a template before you stuff it. Then select standoffs of a length sufficient to allow just the tip of the LED to protrude through the hole in the panel. Also, remember to solder the LED onto the side of the board opposite the rest of the components, leaving its leads as long as possible. This will allow access to the adjustment pots after the unit is mounted in place.

Go ahead and stuff the board now. If you've read the sidebar you know how important it is that you have some way to hold the circuit board while you are working on it. Follow directions, placing the parts precisely as they are laid out for you in the manual. Pay particular attention to placing the right stuff in the right holes in the right direction. You know, it never ceases to amaze me how frequently I get ICs plugged in the wrong way. There is probably no surer way of letting the smoke out of one of these little devils than sticking it in the holes with the notch at the wrong end. If you do, don't worry. The little 556 dual-timer that this circuit uses is available at Radio Shack for about a buck. Better pick up two...and a socket in case your luck stays bad. I substituted a 47 Ω resistor for R-12. (Actually, it turned out to be a 49 Ω one after I dug through the drawer and found one that tested a bit fat). R-12 would normally be an adjustable resistor set to 50 Ω; this is the reference value in the bridge made up of the 50 Ω input to your transceiver and the tuner/antenna combo.

When everything is on board and soldered up tight it's time to attach the various conductors that are needed to wire the thing together. The kit comes with a small amount of RG-174 mini 50 Ω coax to guide the RF on and off the circuit board. There wasn't enough to complete my installation, but it was available locally, so I was able to pick up more. If necessary you can order some from your favorite mail order supplier. Lay in a fair amount of it—it comes in handy. Make all the connections to the board while it is on the bench. I chose to use both positive and negative conductors for DC rather than rely on chassis ground for negative return. Leave the leads long so that they can be cut to length, tinned, and soldered up tight after they have been led to their locations and tied snugly into place. The manual suggests the *optional* placement of a fuse between the transceiver and its input to the board. This is not an option! Buy a fuse holder and *put it in*. I forget now and then to turn off the tuning bridge before transmitting. This is not good! With the fuse in place, though, there probably won't be any damage.

Well, have fun—I certainly did. After you have soldered up the last joint, take a few minutes to verify that everything is connected to its proper place. When first powering a new project I usually leave the cover off and keep a sharp eye out for those little telltale puffs of smoke or glowing wires that indicate a problem. With a project of this type you are not likely to encounter any, but if you do, don't worry. Nothing on this board is difficult to find locally (with the possible exception of R-12/13). If you inadvertently transmit into the bridge, even with the fuse protection, and it quits working, check out R-12; you've probably let the smoke out. Stick a 47 Ω fixed resistor in its place as previously mentioned and you're back in business. 73

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history? It is a war that cost more than WWII, Korea, and Vietnam combined. Hint...it's one we lost. One we lost in a big way. One that has brought about catastrophic changes in our country.

It's President Lyndon Johnson's War on Poverty. Welfare. Welfare mothers. Hey, it's *your* money your politicians are doling out. Over $5 trillion so far, with no end in sight.

When the government pays women welfare benefits equivalent to $12 an hour, two-and-a-half times the minimum wage, in New York and Washington, not to work, what do you think this does to wages in those areas? To be "entitled" to this largess at our expense the women have to have children...the more the better... no job, and no husband who's working.

In 39 states welfare benefits are equivalent to about $16,600 a year. In eight it's over $20,000.

I've already written about a woman with two children who is on welfare in my small New Hampshire town. Her food and apartment are provided, plus schooling for one child, complete with a paid driver to ferry the child to school and back every day. The woman is bitterly complaining that her welfare-provided cable TV only gives her two paid channels. Oh yes, her husband is working, but they are "separated." One of my ex-employees' wives gets $50 a week just to drive the child to school. A recent exposé on welfare showed a couple of women in Laconia (NH) sitting in their apartments getting fat on this same system. Work? And lose all those benefits? You've got to be kidding!

So we complain about the single mothers. We complain about the loss of family values that's turning out one generation after another of uneducated welfare mothers and their progeny with no incentive or skills to work. Compassion gone berserk, and to hell with the "survival of the fittest" concept. We're making sure that the least fit survive and proliferate, dragging us all down.

What can *you* do about this mess you've meekly let fester? Two things. First, we've got to stop Congress from making things worse. Second, we've got to get Congress to strike out the laws they've made that are screwing us up. My bumper sticker approach to this is to start with Green's NRA: Never Re-elect Anyone! Get those bribed (via lobbyists) scoundrels out of Washington. Let's build a whole new breed of one-term politicians.

But most important is to take a few days off from watching mind-numbing TV and educate yourself. There are some damned good books which will help you understand what's gone wrong with our school system, with the war on poverty, the war on drugs, our terrible so-called health-care system, our "correctional institutions," and so on. Hey, we have the potential for having a pretty good country, but it's going to take a lot of work by a lot of people to make it happen.

The multi-level marketing (chain-letter) approach will work for us. First you educate yourself. Then you get two or three other people started being educated. And they do the same for two or three more. The next thing you know, we'll have a movement.

Say, that's not a bad idea for rescuing amateur radio from what now seems like an inevitable doom. If we could get across the idea that every new ham has a responsibility to make sure that he or she elmers at least two new hams, and that each of those do the same, we'd start growing again and have at least a prayer of keeping our hobby going.

In addition to growing local ham clubs, I'd like to see local political action clubs (PACs) get going. Members would be encouraged to read a book and report on it at the next meeting. There are an awful lot of books out there, but only a small percentage of them are interesting and educational. By distributing the work of separating the wheat from the chaff, a group can easily do something that no one person could accomplish.

The same goes for ham clubs too. How about a club project to sort out all of the ham-oriented books and report on them at club meetings? I'd suggest the club buy the books for the club library and then have a couple of the members read each new book and report on it. If the club can organize the bulk buying of the top-notch books, they can pass along the normal discount to the members. For most books this runs around 40-50% off the list price, allowing club members to build first-rate technical libraries at a big saving.

The next thing you know some entrepreneur will start collecting the book reports and submit them to me for publication. And I'll pay for 'em. The resulting sale of the better books will help discourage publishers from unloading crap on us, and will encourage the writing of even better books.

How about it? What book having something to do with amateur radio, electronics, or communications have you read that was really exciting and outstanding? My $5 list of 73 "books you're crazy if you don't read" doesn't have any ham books, but that's because I haven't found any that are outstanding so far. My list does cover a wide variety of topics. Reading these books will beat the heck out of a college education. And be cheaper, and take a lot less time.

Perhaps I've let my idealism run away with me in even suggesting that we try to run our country on reason instead of fanaticism. Maybe screaming protesters and terrorism are the rule of the day and reason passé.

Anyway, if you feel that people who prefer not to work are worth $335 billion of your money being taken out of your paycheck every year, then go back and watch that ball game on TV, or get on the air and ask a few more hams what antenna they're using. As long as you're satisfied that you're getting your money's worth it's no problem.

Continued on page 37

Number 28 on your Feedback card

Foxhunting Deluxe

A compact antenna switching unit for Doppler DF.

Breckinridge S. Smith K4CHE
104 Brookfield Drive
Dover DE 19901

I've been interested in Doppler DF systems for foxhunting for several years. No, let me rephrase that. I have been *obsessed* with Doppler DF systems. Ask my wife—she'll tell you. So when I read KØOV Joe Moell's "A Good Doppler Gets Better" in the April 1995 *73*, the antenna switching techniques got my attention. After all, if Joe uses two diodes to switch each antenna for his Doppler system instead of one, it has to be better, right?

I have never been satisfied with large VHF Doppler antenna systems that are mounted on the car roof. Most of these systems consist of a large plywood or aluminum plate with appendages to improve the ground plane. The switching circuits are usually mounted somewhere under the plane. On UHF the overall size is smaller and you have less wind loading, but on VHF the larger size can be hard to manage. I lost a large VHF array while driving during a hunt, and that cured me of temporarily mounting big heavy things on top of my car. When that Doppler antenna package became airborne it looked like a square flying saucer (and it barely missed wiping out the car behind me).

Joe KØOV then published his article "Wideband Doppler, Part 2" in the June 1995 *73* describing his modification of CB magnetic mounts and mounting the antenna switching circuits inside the Roanoke Doppler chassis inside his car. This looked like a better system since mag mounts have to be better than my flying saucer. I wasn't really happy with the CB mag mounts, but I decided to press on with the project, build the switcher, and shop around for a better magnetic mount antenna to modify.

Photo A. The Dick Smith Doppler unit is on the dash. K4CHE uses the DF for commercial stuck-mike hunting, etc., in Delaware.

The problem with putting the antenna switching circuit inside your system box in your cockpit is that you now have *four* long coax lines running across the roof and down inside the vehicle, over the seats, across the dash, etc. Trying to get these four long antenna feedlines electrically equal is next to impossible. Additionally, on two of the units I tested, these long feedlines appeared to couple to each other and cause reflections which affected the bearings. I decided to build a remote switcher so I could eliminate most of those feedlines. Since I already have several holes in my van roof (I told you I was a DF fanatic), I was able to put the four mag mounts near the hole and mount the new switcher box just inside the roof. That provided short feedlines, good decoupling from the antennas, and a neat installation.

Circuit construction

The small switcher unit puzzled me for a while. On the KØOV dual diode switcher circuit the majority of the surface board is at a positive 3.7 volts DC potential, so it has to be isolated from ground. Joe solved the construction problem in his "Part Two" article by using a "Dremel Moto-Tool© as a router to insulate the center of the board where the four single-hole coax fittings mount."

So I built a remote-mounted switcher box using copper-clad board and used the same Dremel tool routing techniques. Basically, I used a double-sided PC board and cut it to fit the top of a standard Bud box. Using a double-sided board and a sealed box made the circuit

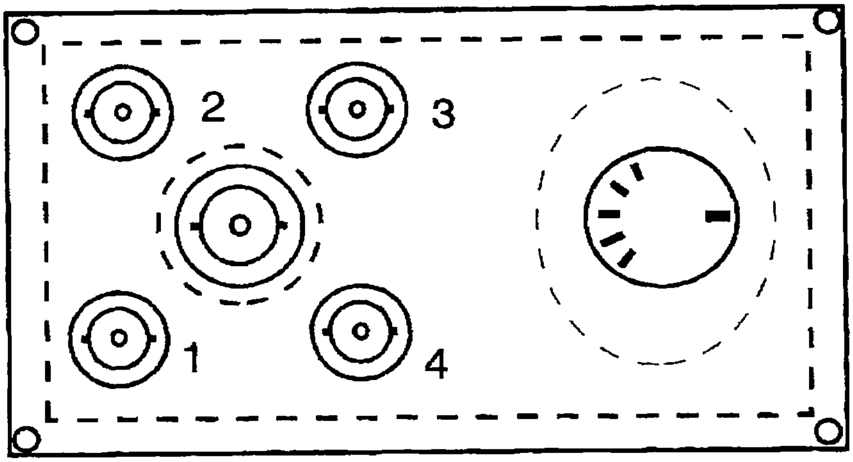

Fig. 1. Top view of the switcher.

well-shielded. BNC connectors reduced the board size and increased the connector reliability. Routing techniques were used to isolate the hot 3.7 volt area from the box case. These routed areas are indicated by the dashed lines in **Fig. 1**. The holes to mount the board to the aluminum box are drilled outside the routed areas and the DIN connector mount area is also isolated. The routed area is on both sides of the double-clad PC board. The center BNC connector for the receiver coax is isolated from the board inside its own dashed circle (routed) area. Use high quality Teflon™ BNC connectors so you can solder the nuts to keep them tight and have reliable connections. You will have to refer to Joe's schematic in his column "Homing In" in the April 1995 *73* to get the big picture. The component values are published in both the April and June (1995) issues of *73*.

The pin diodes all are mounted and connected between each antenna's BNC center pin and a small insulated standoff connection point. Remember that the cathode end goes to the insulated standoff connection point. The 680 pF RF coupling caps (C101-104) are then connected from the insulated standoff connection point to the pin of the center BNC to feed the receiver. Switching signals are supplied through the RF chokes (L101-104) which are connected between the pin diode/coupling cap standoffs and the choke input bypass capacitors (C105-108) and then a connection is made to the appropriate pin on the DIN connector. See **Fig. 2**. On most of my VHF/UHF projects I like to wind my own chokes to the frequency that I plan to use. Joe's directions for winding the chokes using a 2 meter quarter-wave of wire (19.5 inches) are in the June 1995 issue.

"Do away with the octopus—eliminate the flying saucer with Doppler DF!"

I soldered the bottom of each choke input bypass capacitor by a short lead directly to the copper board and mounted these caps vertically on their ends. These vertically mounted bypass capacitors now serve as mounts for the other ends of the chokes as well as performing their bypassing function. See **Fig. 2**.

If you're careful you'll wind up with equal lead lengths on the coupling capacitors and the whole switching circuit will be symmetrical. When soldering your wires on the DIN connectors, remember that the pins are not in order and DIN pin labeled number 1 goes to antenna number 1, etc. Don't forget C109, which provides an RF path from the routed center receiver BNC mount area to the main board area. You might want to install and solder this capacitor first, as it may be hard to get to later. Choke L105, which provides the +3.7 volts to the main board "P" area, can be soldered last.

Magnetic mount modifications

My preference is the Motorola magnetic mount. It has a 1/8-inch rim that allows you to grasp it easily for removal. In addition, the mount is hollow in the center. The 1-1/4-inch hole in the center can be accessed by cutting through the plastic that covers the magnet's bottom. This large access hole makes it easy to modify the interior, and later on you can even change the feedline (after you've slammed the RG-58 feedlines in your door a hundred times).

Motorola provides different antenna whips that are cut for different frequency segments: the low split whip (see the Parts Resources at the end of this article) covers 144 to 152 MHz, with a center frequency of 148. I have used these precut antennas without any problems, even though the center frequency is a little high for the ham band. There are other brands of whip kits available that will fit the Motorola mount. Coverage of the entire amateur band and beyond can be accomplished with an Antenna Specialist quarter-wave kit (part number ASP695). This antenna comes with a .072 diameter whip that can be trimmed and the hardware threads are compatible with the Motorola mount. With this antenna kit you could use different lengths of piano wire whips for each VHF segment you want to cover.

Modifying the Motorola mount is easy. Cut a circle in the clear plastic bottom cover. Carefully and quickly unsolder the center conductor from the center pin, using a good-sized iron. Let the center insulation cool and then bend the center conductor away from the center pin and mount your pin diode from the center conductor to the center pin of the mount.

Then mount the 270-ohm resistor from the shield clamp to the center pin. Use a piece of tape for insulation under the diode and resistor. Using this construction technique you will wind up with very short resistor and diode leads, so it's easy to keep lead lengths the same length on all of the mounts. After the mag mount surgery is over, repair the access hole with mailing tape—the clear tape that is 2 inches wide. You might want to put on an additional layer of clear tape on the bottom of your mount to protect your car roof and to further insulate the mount from the vehicle. Remember, the ground portion of the mag mount is at a positive 3.7 volts.

Testing

I was worried about how much noise might be generated by the extra

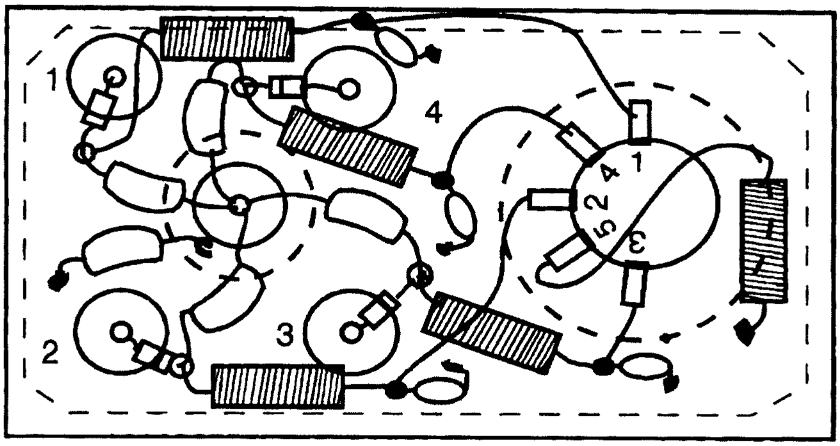

Fig. 2. Bottom view of switcher.

switching diodes, and their effect on the overall sensitivity of the system. After several tests out in the field I couldn't hear any noise increase due to the switching system with it mounted just inside the van cockpit, directly under the antennas.

Using my Dick Smith Doppler I mounted test connectors for the original switcher and the KØOV dual-diode circuit and ran comparison tests. With the dual-diode switching, the overall sensitivity of my Dick Smith Doppler system increased several microvolts. Additional tests with the Roanoke produced the same sensitivity and I could actually get some indication of stations that were well down in the noise. This was more evident on my Dick Smith system as it has 32 LEDs and appears to be more responsive visually to weak signal detection, as opposed to the 16 LEDs of my N6ZAV display. I know I will get a lot of comments about the 32 LEDs, but I like to see multipath to analyze it, and with the 32-LED display you get more information. In addition, with the 32-LED Dick Smith and the inherent "circling LED" you know when you are detecting a weak signal because the circling LED stops circling on a noisy weak signal and presents you with a multiple LED segment that just sort of jiggles back and forth, providing you with a rough direction indication.

When testing your mag mounts and remote switcher, a good troubleshooting hint furnished by KØOV is that you should have a couple of volts on each antenna (less than 3.7 volts due to the diode drop), and the voltages on each antenna should be equal if the diodes are OK. A 16-inch spacing seems to be best between each antenna, but Joe published "18 inches" in the June issue. With the mag mounts you can experiment with the spacing and reach your own conclusion. RF near-field testing with a 25-watt signal from two feet away did not blow any switching diodes.

Get out the Dremel tool; start routing. Now you can do away with those "octopus" leads that are strung across the seats and/or eliminate the flying saucer mounted on top of the vehicle. If you are new to Doppler, this system will solve the antenna dilemma. Many thanks to Sam K3BY who assisted in the testing and building of duplicate switching units and antennas. Good hunting.

References

Joe Moell, *73 Amateur Radio Today*, April 1995, page 68.

Joe Moell, *73 Amateur Radio Today*, June 1995, page 54.

Parts Resources

Diodes, chokes etc. are listed in the reference articles.

Motorola magnetic mounts can be ordered direct from the Motorola parts division at 1-800-422-4210. Motorola part number for the mag mount with 12 feet of RG-58 is 01-80355A91. Motorola part number for the lo-split whip (144-152 MHz not adjustable) and chrome base nut is 01-80352A06.

The Bud "Econoboxes" part number is CU-124 and can be ordered from Allied at 1-800-433-5700. Ask for Allied stock number 736-3600.

An Antenna Specialist whip kit that can be trimmed is manufacturer part number ASP695 and is available from Tessco, 1-800-472-7373. Ask for Tessco part number 94090.

Number 32 on your Feedback card

The 2 Meter Diamond Beam

It could be a real gem in the rough.

Thomas M. Hart AD1B
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While reading the ARRL *Antenna Compendium Volume 2*, I encountered an antenna design I hadn't seen before. In an attempt to minimize the footprint of horizontally polarized HF beams, G.A. Bird G4ZU used a linear driven element in conjunction with a director and a reflector bent at 90° angles. Refer to **Fig. 1** for more information about the diamond shape of the antenna.

A number of other experimenters have proposed variations of beam antennas without planar parallel element designs. In his book *HF Antennas for All Locations*, Les Moxon provides information on at least three beams featuring elements that are bent in a variety of angles. In the RSGB text *High Frequency Antenna Collection*, Erwin David G4LQI describes a two-element beam that features acute-angled elements. A final design that has been popular is the X-Beam described in the *Antenna Compendium Volume 1* and in the periodical literature. The tails on the X-Beam apparently contribute to the emphasis of front and rear lobes; a straight element X-Beam has four equal lobes (see the Moxon text for details).

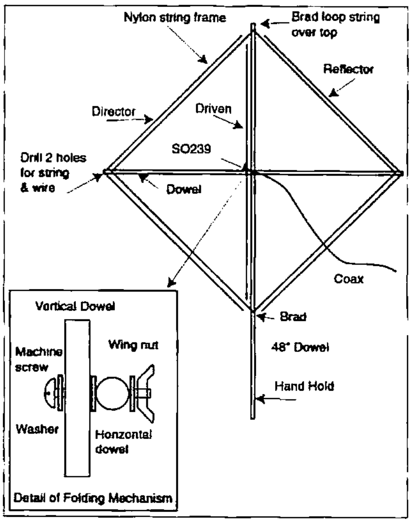

Fig. 1. Construction details for the 2 meter diamond beam.

After modifying the diamond design for 2 meters and switching to vertical polarization, I built a satisfactory three-element portable VHF beam. The entire contraption weighs little more than my Kenwood hand-held rig and is designed to fold into an easily transportable four-foot-long shape. I would not necessarily use it as a walking stick, but it is similar in size.

My intent was to build a 2m beam that could be used while hilltopping, traveling, or for emergencies. The beam must be light, easy to transport, and as compact as possible when not in use. Most importantly, construction has to be inexpensive. Moreover, three elements seemed to be the smallest design that would be of any real practical use.

Construction

By selecting 5/8-inch diameter wooden dowels for the frame and insulated wire for the elements, I was able to accommodate all of the basic requirements. Actual construction entailed the following steps:

1. Rough-cut a 38-inch long dipole, to be tuned to the center operating frequency desired by means of an SWR meter.

2. Tape the dipole to the top of a 48-inch dowel and carefully trim the ends until a 1:1 SWR is achieved. After finding the correct length, use a wood screw to fasten the SO-239 connector to the dowel. Use tape to hold the dipole against the wood.

3. Measure the length of the dipole and cut a director (95% of driven element) and a reflector (105% of driven element).

4. Cut a second dowel 2 inches longer than the driven element and mount it perpendicular to the vertical support using a machine screw, washers, and a wing nut. This arrangement allows the frame to be folded when not in use. Small brads are used at the top and bottom of the vertical dowel to hold the string framework in place. By making the horizontal brace 1/2 wavelength, the element spacing is 1/4 wavelength at the centers and the diamond shape is achieved.

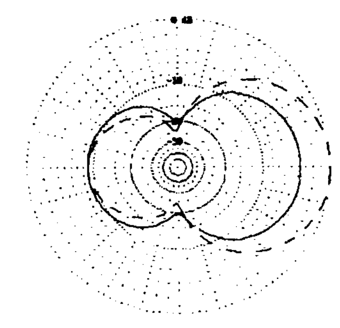

Fig. 2. Comparison of a traditionally-shaped commercial (MFJ three-element portable) antenna and the 2m diamond beam, using Eznec software.

"The beam is light, easy to transport, compact when not in use, and, most importantly, inexpensive to build."

5. Using nylon string, fasten the director and reflector into place, and use a spring-loaded clothespin for coax strain relief. When folded for transport, the top and bottom string supports are released from the brad. The wing nut permits quick tension relief for folding.

6. The final assembly step is to recheck the SWR; some additional trimming of the driven element will probably be necessary to overcome the effects of the parasitic elements. Cut the dipole in very small equal increments at both ends for best results.

Refer to **Fig. 1** for basic construction details. All components should be available at either Radio Shack™ or your local hardware store. I have been using a 40-inch piece of RG-8x to connect the antenna to my 2m rig. I used a Radio Shack 2m SWR meter to obtain the lowest possible SWR.

Testing

After completing the construction, I made some simple tests of the antenna and raised all the area repeaters without difficulty. More interesting was the fact that there were new simplex frequencies open for me to explore. I monitored the 147.21 repeater from Maine (which is often heard in the Boston area) and found that by turning the beam from side to side, I could change reception from 100% copy to inaudible, indicating reasonably good directivity.

I used Roy Lewellan's latest antenna software (Eznec) to compare the diamond antenna to a traditionally-shaped commercial beam. The results show that the diamond shape antenna is a perfectly viable alternative. I measured my MFJ three-element portable beam and loaded the element sizes into Eznec. I did the same for the diamond beam and compared the patterns of each (**Fig. 2**). Not surprisingly, the MFJ antenna has a sharper pattern to the sides and a better front-to-back ratio, but the diamond beam does surprisingly well for a package that weighs and costs only a fraction of the amount of a commercial antenna.

In conclusion, anyone in need of a simple 2m beam should review the available ham literature and decide if the diamond beam fits the bill. Read the original article by G4ZU in the *Antenna Compendium Volume 2*. At the end of the process, you will be hard pressed to find a simpler compromise antenna design than the diamond shape.

Oersted...Faraday...Tesla

Their discoveries created our worldwide system of electric power.

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The discoveries made by these three Giants of Electricity, perhaps more than any other scientific breakthrough since 1888, are responsible for advancing mankind as no other discovery has since Johannes Gutenberg invented the movable type printing press in 1453.

The early experimenters

Focusing on three is probably unfair to many others who also made significant contributions in electrical science. André-Marie Ampère (1775-1836), a mathematician, and Georg Simon Ohm (1788-1854), a schoolteacher, made truly significant contributions establishing the science of electrodynamics and electrical conduction, respectively. The properties of electromotive force in Ampère's time were in a constant state of interpretation and revision by many investigators; however, it was Ampère's brilliant deduction that solved the scientific riddle. Between 1820 and 1823, Ampère experimented with current-carrying conductors and reasoned that electromotive force is manifested by two kinds of effects: electric tension and electric current; thus, he established the concepts of voltage and current. Three years later Ohm defined the exact relationship between these two entities. Today, Ohm's Law remains the most basic and universally used of all laws in electrical science.

There were many others who made advancements, too numerous to mention in this short account; however, the names of Joseph Henry (1797-1878), James Clerk Maxwell (1831-1879), and Heinrich Hertz (1857-1894) stand out prominently. Henry, an American physicist experimenting with electromagnets in 1831, discovered *self-inductance*, a separate phenomenon of electromagnetic induction. Maxwell, a Scottish mathematical genius, established the laws of *electrodynamics* by formulating four fundamental equations defining the electromagnetic theory. He concluded that energy could be transmitted by electromagnetic waves at the speed of light. Hertz was convinced that Maxwell's mathematical postulates were correct, so he set out to interpret and prove Maxwell's work through experimentation. The experiments proved those postulates—that electromagnetic waves were indeed propagated in air at the speed of light.

In most long and arduous journeys into the unknown, interim breakthroughs are reached before the ultimate goal is achieved. The journeys traveled by Oersted, Faraday, and Tesla clearly illustrate this reality. In short, these men made those pivotal breakthroughs in electrical research that resulted in our worldwide system of electric power.

"*Without realizing it, Oersted had discovered the magic doorway that would ultimately lead to the age of electricity.*"

One thing is certain: The single characteristic most great scientists share is *insatiable curiosity*. Perhaps more often than not, luck plays an important role and a great discovery is made accidentally when the curiosity seeker simply stumbles upon an eternal principle—often try not to split doing so without realizing the significance of his discovery.

Thales of Miletus was one of the "seven wise men" of ancient Greece who lived some 2,500 years ago. In his search for the substance from which everything in nature is made, he accidentally discovered static electricity by rubbing a piece of amber with cloth, resulting in the amber attracting bits of feathers and the pith of plants. The discovery of the lodestone's magnetic attraction is another example of early "curiosities in nature" that ultimately led to present-day knowledge...a world these early curiosity seekers could not possibly envision.

It was not until many hundreds of years later that the next truly significant advancement was made. In 1453, Johannes Gutenberg changed civilization forever with his movable type printing press, a significant factor in the beginning of the Renaissance period that swept through Europe. The Renaissance is characterized as a rebirth in all forms of learning, including a revival of interest in the wisdom of the ancient world of the Near East and Greece. Two names from that period stand out as beacons lighting the way for others to follow: Galileo Galilei (1564-1642), an Italian; and William Gilbert (1544-1603), an English physician. They were the first to reject ancient thinking, which for hundreds of years had dominated man's knowledge of his world. Galileo is called the founder of modern experimental science. It was his bold defiance of ancient teachings that established the beginnings of the scientific method. He made his own telescopes, the largest available, and gathered much new information about the moon, stars, and planets. In addition, his experiments with the pendulum and falling bodies changed forever previously held beliefs adding greatly to the understanding of physics. In England, Gilbert's scientific study of the magnet culminated in a monumental

treatise entitled *De Magnete*. His quest was to improve the accuracy of the magnetic compass for better navigation on the seas and oceans. What he never realized was that he also laid the foundation of magnetic science, a key element that eventually led to the generation of electricity.

Pioneers in the age of electrostatics

Gradually, scientific investigators entered a period dominated by the study of electrostatics which was thought of as a curious phenomenon of nature with little or no practical value. The major thrust of scientific investigation during this period, as far back as Gilbert, still centered on improving the magnetic compass, although many independent investigators were working on the properties of conductivity. Charles A. Coulomb (1726-1806) was most prominent during this era because he established the fundamental laws of static electricity, and later made significant advancements in the manufacture of compass needles. Investigators became proficient at generating and instantly discharging static electricity, but they had no way of storing it. E. G. von Kleist and Pieter van Musschenbroeck bridged that gap in the early 18th century with their invention of the Leyden Jar, a capacitive device that could store static electricity for discharge later. It became a novelty item for royalty who took pleasure in shocking unsuspecting victims. It was all in good fun, but there was still no hint of where electrical investigation would eventually take mankind.

Then, in 1800, Alessandro Volta (1745-1827) made the first electrochemical cell and battery capable of producing continuous electric current. His inspiration came from Luigi Galvani (1737-1798), a physician who had been conducting experiments with frog legs hung on brass hooks. The legs convulsed when he touched a piece of iron to the framework. Galvani proposed a theory of "animal electricity" as the reason the frog legs had muscle spasms. Volta disproved this theory, stating accurately that the frog legs convulsed as a result of their being in contact with two different metals. His metal theory intrigued him, so he conducted numerous experiments. Eventually, Volta created a chemical cell capable of producing a continuous electric current. He assembled zinc disks alternately with silver disks, separated by pasteboard soaked in brine solution, and called it an "electric pile." No longer was static electricity the only form of electricity known to man; Volta's continuous current cell was indeed a milestone in the annals of discovery. It was Volta's chemical cell that truly put electricity on the move, and today the battery is still an important, although minor, source of electrical energy.

Michael Faraday worked diligently toward his goal until he achieved it. If Oersted discovered the magic doorway that would lead to the age of electric power, it was Faraday who unlocked that door. His public wondered what use could possibly come from producing a small current by moving a magnet near a length of wire...the Genie still needed to be tamed to become man's tireless servant. Faraday understood the far-reaching possibilities and is said to have replied, "What is the use of a new-born baby?" Further example of Faraday's wit has become English folklore. The Prime Minister is said to have asked him what use could be made of his discoveries. Faraday allegedly responded, "Someday it might be possible to tax them."

"More often than not, luck plays an important role and a great discovery is made accidentally when the curiosity seeker simply stumbles upon an eternal principle."

Oersted

The next exciting event took place in 1820, in the classroom of a Danish professor named Hans Christian Oersted (1777-1851). He was conducting an experiment with one of his students, showing him how a wire could be heated when it is connected to a voltaic pile. Oersted had neglected to clear the table after his previous experiment, and a magnetic compass remained near the wire. When the connection was made to the voltaic pile, the compass needle turned and pointed toward the wire. At first, Oersted could not believe what he had seen, but ultimately he realized he had discovered something new: Electricity and magnetism were interrelated. He named this new force in nature *electromagnetism*. Without realizing it, Oersted had discovered the magic doorway that would ultimately lead to the age of electricity.

Michael Faraday

Michael Faraday (1791-1867) made the next giant step on the long road leading to modern-day electric power. The impetus that set him on his series of epoch-marking experiments was news of Oersted's discovery of electromagnetism. Faraday reasoned that if electricity produces magnetism, then why shouldn't magnetism produce electricity? Finally, in 1831, his experiments revealed a great truth: Electricity could indeed be produced by magnetism; however, the critical component of his discovery was that magnetism must be accompanied by motion. Unlike Oersted, who accidentally stumbled upon his discovery of electromagnetism,

For the next 51 years, man struggled to increase the electrical output of Faraday's embryonic generator. His genius had shown the way; now it was up to engineers to make progressive refinements of his discovery. Volta's batteries had been used initially for electroplating metals, but they were large and very expensive. Gradually, engineering advancements in magneto-electric generators surfaced. Besides their use in the electroplating industry, these first generators were also used for powering arc lamps, lighthouses, and naval vessels. Arc lamps required DC, so a commutator was necessary for rectifying naturally-occurring AC. By 1872 the DC generator had reached its peak of refinement, and DC motors had also come into limited use, but they proved to be inefficient and troublesome, creating sparks and requiring frequent maintenance. In addition, DC power was inherently inferior due to its I^2R voltage loss, and could not be sent a distance greater than half a mile from the generating station. DC also required inordinately large cables to transmit the current, making it very expensive. Nevertheless, this was the only path man knew to follow.

In 1880, the Menlo Park group, headed by Thomas Edison, invented the first practical incandescent lamp, which was a much needed improvement over

the power-hungry and dangerous arc lamp. Edison, whose thirst for entrepreneurial conquests exceeded (or perhaps equaled) his popularity as an inventor, saw the opportunity to capitalize on the new incandescent lamp by using existing DC technology as a power source. He attracted investors to fund the construction of a power station in New York, and soon more DC power stations were built in America and abroad. Their existence proved to be a short–lived evolutionary trend, doomed to extinction due to their inherent inefficiency. DC power, even in its refined state, barely cracked the door to the awesome power contained in Faraday's Genie.

Tesla

Harnessing alternating current was deemed impossible by leading authorities, including the physics professor of a young engineering student in Austria named Nikola Tesla. His idea was the exact opposite of his professor's, and he set out to prove that AC could indeed be harnessed. Professor Poeschl and his classmates laughed at him, but he was undaunted. For two years Tesla went into a state of self-imposed exile, devoting his entire energy to solving the AC conundrum. He sensed that the answer was hidden in his mind and would eventually come forth, but the mental anguish he suffered during his search nearly killed him, so strong was his resolve. Then, in 1882, the solution came suddenly, in a blinding flash, as he recited poetry while walking in a park. In that instant, his brilliant mind conceived perhaps the most beautiful and ingenious scientific creation since the invention of the wheel. In a sense, it was very much like the wheel; he called it the *rotating magnetic field.*

"In that instant, Tesla's brilliant mind conceived perhaps the most beautiful creation since the wheel; he called it the rotating magnetic field."

Tesla's understanding of the awesome power contained in Faraday's Genie was clearer than any of his contemporaries could imagine. The problem of how to harness that energy to do the work of giants had dogged him for more than two years, and now he had discovered the final solution to make alternating current man's servant! The scientific community had always regarded AC as equal to a perpetual motion concept—utterly ridiculous! During Tesla's sudden burst of brilliance on that day in the park, he not only conceived the rotating magnetic field but an entire system of *polyphase AC* that has remained unchanged in principle to this day. Energy in the form of electric power could now be used in virtually unlimited amounts anywhere. His rotating magnetic field discovery, equal in importance to Oersted's and Faraday's pioneering achievements, is a principle of unfathomable beauty that will live forever. It stands today as the foundation on which our entire world operates. Indeed, the power of Faraday's Genie, captured by Tesla, was, and still is, the most important scientific discovery in more than 500 years. Tesla had not only opened Faraday's magic door, his polyphase system literally blew it off its hinges and took the entire wall with it.

Today, the world owes Oersted, Faraday, and Tesla a tremendous debt of gratitude, for it was their monumental discoveries in electrical science that gave us the power to run our factories, mills, schools, hospitals, research centers, stores, and homes.

Technological advances are happening at an ever increasing rate, and we seem always to be looking forward—which is good, but would it not also be uplifting to look back and acknowledge, even pay homage, to the pioneering spirit of those whose efforts laid the foundation for all the technological advantages we enjoy today? Our schoolbooks, teachers, and professors seldom mention these pioneers (if indeed they know anything of their existence). Further, many historians and book writers have elevated the names of entrepreneurs and technologists, crediting them with discoveries made by early pioneers, and if we are not more mindful, our historical heritage will be lost forever. 73

NEVER SAY DIE

Continued from page 29

One ham suggested a way to solve the deficit problem would be to fire the top three layers of management of all federal bureaus on the basis that it's unlikely that anyone lower down would notice much difference. Oh, the bureau's jet planes would get less use. But why not fire 'em down five levels and start reducing the deficit instead of just stopping its growth?

Oh yes, one more innovation. Since many of our more serious social problems have been caused by federal judges running amok, bypassing the legislative system, how about putting term limits on those rascals too?

Bioenergizer Update

Bob Beck called with some suggestions for researchers working with doctors toward the elimination of crud in the blood, as described in the lead article in May. Firstly, don't use any metal in contact with the skin, since even low levels of current can cause burns. Bob recommends that the electrodes be made of heavy wire cut one inch long, or perhaps a nail, wrapped with flannel. The flannel can be held in place with heavy thread. Then you soak the flannel in a saline solution to provide conductivity.

In my experience, if you don't get the electrodes exactly over the wrist veins and in line with them, you can still get some slight burns. They don't hurt, just itch. You can feel the throbbing when the electrodes are exactly in place. I use a 1-inch wide strip of elastic with hook-and-loop fastener on the ends to hold the electrodes in place on my wrist, and a second an inch farther up the arm to keep the wires from yanking the electrodes out while I'm working or typing.

Bob also recommends the use of a 100k pot instead of 1 meg to give better control of the voltage. And he says not to use more than three 9V batteries (27V). Though there have been no reported problems with heart pacers, there is the potential for such trouble, so the best bet for doctors researching this field would be to avoid pacer patients until more is known.

Bob is promising a media announcement of the results achieved with this procedure in the near future, which should make it easier for you to find doctors interested in this approach to dealing with AIDS and other blood-carried problems. I gather that eliminating the HIV virus doesn't take very long, but the rebuilding of the T-cells can take around 90 days.

If you want to learn more about AIDS I suggest you read the books by Duesberg, Douglass, Batmangheldij, Comby, and Wallach. If you are more interested in misinformation, read your newspapers and watch TV. People *are* being saved, even from the last stages of AIDS.

Can the bioelectrifier also help people lose weight and regrow hair? Hey, get together with an interested doctor and you tell me. He doesn't have the electronic smarts to build the unit and you don't have his license to kill, so you need each other. Of course, that presupposes that you'll be able to find a doctor not totally indoctrinated with the semi-religious belief that AIDS is incurable.

My experience (and Bob's) with AIDS workers is that they get all upset over the prospect of a simple, inexpensive cure. I've had them scream at me in rage that AIDS is incurable, and then stalk away, just at the *suggestion* that this new approach should at least be tested.

But hey, with over 300,000 deaths yearly due to hospital error and negligence (according to a Nader study), what's a few thousand more deaths, right? Unless that's *you* being rolled into the hospital, of course. Well, the odds are about 10:1 that you're there because you haven't treated your body right, and the odds now are that the doctors aren't going to be a lot of help, but they and the hospital are going to make a ton of money. I served on the board of directors of our local hospital, so I've seen all this first hand.

Number 38 on your Feedback card

73 Review

The MFJ-9406 6m SSB Transceiver

6 meters: The adventure begins.

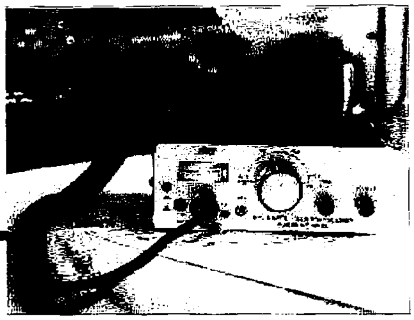

Photo A. The MFJ-9406. (Photo by Conard Murray WS4S.)

Jeff Gold AC4HF
1751 Dry Creek Rd.
Cookeville TN 38501

There are large numbers of new hams entering the hobby with the no-code Technician license. Unfortunately, most of these people are limited to experiencing only one small aspect of ham radio. Many seem to get on 2 meters and talk on repeaters. They are allowed to operate SSB and CW (phone and code), but may not be aware of how much more fun they can have. I believe that the more these people are exposed to other aspects of the hobby, the more they will be motivated to upgrade.

I've had a blast with the MFJ 20 meter SSB rig. It's small, portable, and works *great!* I have used it for the University Ham Club's QRP Expedition and during many SSB contests. When MFJ announced it was coming out with a 6 meter version, I had to have one. With great expectations, I waited for my new 6 meter rig to arrive. One of the best things about ham radio is trying different aspects of the hobby. I was eager to try 6 meters.

My new toy finally arrived. I opened the box and took out the rig, with its matching microphone (my MFJ 20 meter rig's matching mike worked super so I'd decided to get one with this rig). I found a spare spot on top of my operating bench, which in itself was a small miracle, then I looked around on the floor and found the appropriate DC plug to match the rig. I *very* carefully checked the voltage and polarity before plugging it into the new rig. I have a wide variety of DC plugs and alligator clips that allow me to get power to about any type of equipment. I remembered reading that my Gap vertical was resonant on 6 meters so I hooked it to the rig.

How do I sound?

I pushed the red power button and the rig instantly came to life. I turned the main tuning knob and picked up a signal. Using the smaller fine-tune knob, I tuned in the voice until it came out clearly. The rig has plenty of audio to drive the built-in speaker. I had the volume up only a little way and it was more than loud enough. I heard Jay KE4NYH calling CQ for some type of contest. I've worked my share of HF contests both on CW and SSB, but hadn't worked a VHF contest yet.

"This rig is about as simple to operate as it gets—it takes all of about five seconds to get used to it."

I answered Jay's call and he immediately came back to me. He told me some strange letter combination, "EM65," and I gave him my name, QTH, and his signal report. I stopped him before he could give the standard contest good-bye to ask for a detailed report on how the rig sounded.

"Sounds real good, real good audio quality," Jay said.

I explained that I was testing out a new rig and he was my first contact. He said, "Hope my rig sounds as good as yours does." This was high praise coming from someone on a full powered base station transceiver.

I later spoke with Jim WA4SOH, a veteran 6 meter operator. He gave me a 10 over 9 report. "Not too shabby for using low power on a vertical," Jim said. "Good audio. Yours is the first MFJ 6 meter I have heard. You're doing well—I'm impressed."

I talked to Jim for a long time about the rig, the way it sounded, and about the 6 meter band in general. Jim runs a Kenwood 690 with a five-element Yagi. He later told me, "If I didn't own this Kenwood I would purchase the MFJ."

Another opinion

I also talked with the local 6 meter guru Conard Murray WS4S. We talked for quite a while and he also was impressed with the way the rig sounded. He helped me while I played with the processor level. I then changed to my 160 meter dipole using a manual antenna tuner. The receive signal went way up and so did my signal report. Conard talked to me about using a beam on 6 meters. I plan on getting a loop or a beam to increase my effective signal strength, but meanwhile I am having a lot of fun with the 160 meter dipole.

Conard talked me into letting him test out the rig for a while.

"Overall, I was very impressed with the radio," Conard said. We discussed his impressions and findings. He found the rig to have good selectivity. "When you tune off a signal, it drops off and disappears. You can really separate out signals. The front end doesn't overload from very strong signals. The AGC (Automatic Gain Control) action on local signals is good. These signals sound natural and don't get distorted. The rig also has good sensitivity. If there is a signal in there, you should be able to hear it on this rig if you can hear it on a main station rig. It has good physical stability; you can bang on it, take it mobile or mountaintopping/portable and it

will handle the roughness. It makes an excellent starter rig for 6 meters and should be great for new or old hams. It also makes a fine portable rig and you should be able to run it for a good while off a gel cell."

Lots of assets

Operation is about as simple as it gets. There is an on/off push–button in the lower left corner, right under a combined S-Meter/Processor output meter. Next to the on/off button is the mike jack, then the transmit on LED. There is also a key jack for the optional Semi-QSK CW module that will be out soon (I can't wait to test it). There is a large tuning knob in the middle of the front panel, next to a smaller fine–tuning knob and an audio volume control. It takes all of about five seconds to get used to the rig.

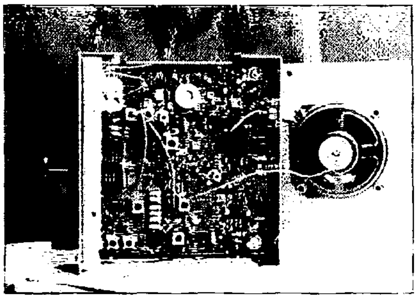

Photo B. Inside this 6m rig. (Photo by Conard Murray WS4S.)

"Plenty of audio to drive the built-in speaker—I had the volume up only a little way and it was more than loud enough."

On the back panel is the mike gain control, the 12-14 VDC power jack, and the SO-239 jack. There is also an external amplifier jack that uses a solid-state FET switch to key an amplifier, such as the Mirage A-1015-G.

The rig is small and rugged; it has low current drain and can operate on a D-cell NiCd pack or a small gel cell. Operating from the home, it will work with any 2A AC supply.

I didn't notice any drift after leaving the rig on for a while, and I was impressed with how natural the other operators sounded on it. The selectivity seemed good. It has a 2.3 kHz HF-style SSB ladder filter that reduces passband noise, helps to fight some of the QRM, and works on getting some of the weaker signals to come through and be understood.

The transmitter puts out 10 watts PEP. It has a Constant Current™ syllabic speech processor that MFJ claims gives an added 4-6 dB advantage to help cut through noise. I'm not one to dwell on technical specifications, but rather on how well things actually work. The 20 meter MFJ rig and this one both do *very* well with the amount of power put out, so I guess I believe that the processor works. I have had operators who were working high-rate HF contests stop and tell me how good the 20 meter version sounded.

The 6 meter band seems to have a personality all its own. There are times when it is totally quiet; other times you can work good distances with very low power. I think this new MFJ rig is a terrific way to try out a new band without investing a fortune. I am very pleased with it. 73

Manufacturer's Specifications

Receiver Station

Frequency coverage: 50.000-50.3000 MHz
Receiver type: Single–conversion superhet
Frequency control: Heterodyne VF, low–side injection
IF frequency: 10 MHz
IF selectivity: -6 dB @ 2.5 kHz
AGC: Audio–derived, 70–dB dynamic range
Sensitivity: .15 µV for 12 dB S/N
Audio: 1 watt into 8 ohms at 10% THD
Average Rx current: 60 mA (S-meter lamp disabled)

Transmitter Section

RF power output: 10 watts PEP
VSWR tolerance 3:1 VSWR maximum
Peak Tx current: 2.0A
Speech enhancement: RF compression, syllabic rate
Spurious attenuation: 60 dB
CW generation: 600 Hz tone (with optional installed)
Mike input: 600 ohms dynamic

Number 40 on your Feedback card

Carr's Corner

Joseph J. Carr K4IPV
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Falls Church VA 22041

This month we're going to take a look at some recently-announced ham products, and answer a question or two from the mail bag. First the stuff:

Ameritron AL-800H amplifier

It seems that there is another pair of "loudenboomers" on the market (**Photo A**). A recent news release from MFJ Enterprises, Inc. [P.O. Box 494, Mississippi State, MS 39762; (voice) 601-323-5869; (FAX) 601-323-6551] announced the Ameritron AL-800H linear amplifier for the high frequency ham bands. It is rated at what MFJ calls "1,500 watts plus."

The list price is $2,295, which, given the price of everything else these days isn't terribly bad (you ought to see the price of the "645" medium format camera I recently looked at—errr...pined over—it makes the AL-800H look cheap).

There are actually two models of the AL-800 amplifier. The straight AL-800 uses a single Eimac 3CX800A7 power amplifier tube, and runs to powers up to 1,250 watts. The addition of the "H" suffix, to make the model number AL-800H, means that the amplifier uses a pair of Eimac 3CX800A7 power amplifier tubes, at powers of 1,500-watts-plus. The AL-800 and AL-800H are designed for legal operation over the range of 160 meter and 10 meter bands.

The AL-800/AL-800H feature a tuned input circuit, output network, tube protection (those Eimac 3CX800A7 power amplifier tubes are pricey!), Automatic Load Control (ALC), vernier reduction drives for tuning, a

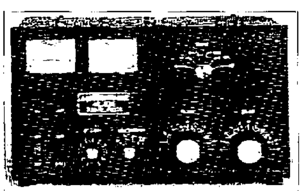

Photo A. The AL-800/AL-800H linear amplifier.

heavy-duty power supply (particularly important in power amplifiers), and a Step-Start Inrush Protection™ program (means longer life for those expensive bottles).

The tuned input circuit is an adjustable slug-tuned input circuit, which is common practice on HF linear amplifiers. The output network is the π/π-L design, which is claimed to provide smoother tuning and a wide impedance matching range.

The AL-800/AL-800H also have a grid circuit that limits grid current and thereby protects the tubes. Again, the Eimac 3CX800A7 power amplifier tubes are a major contributor to the price tag of linear amplifiers, so any protection is well warranted (grid current violations are major murderers of RF power tubes—I whacked my share of 6146B, 807, 1625, 813 and an occasional 4-400A in my misspent youth when I didn't understand grid current and overdrive!).

"Grid current violations are major murderers of RF power tubes"

The illuminated front-panel meters use the popular cross-needle design. These meters read peak forward power, reflected power, VSWR, high voltage, grid current and DC plate current.

The power supply of these linear amplifiers can be set for operation over 90 to 140 VAC, or 200-250 VAC; 14 settings of the AC primary voltage are possible. My own prejudice, by the way, calls for operation of kilowatt-and-up RF power amplifiers from the 220-VAC line. It requires a special outlet (of the sort that electric clothes dryers use, but not necessarily as many amperes (my linear amplifier is connected to a 220-VAC 20-ampere line that is dedicated to only the linear amplifier).

For information, call MFJ (as above), or Ameritron (116 Willow Road, Starkville MS 39759) directly at (601) 323-8211, or order direct at 1-800-647-1800.

Cross-Needle SWR/ Wattmeters

The other product line we'll look at this month is also from MFJ Enterprises, Inc. These products are RF wattmeter/VSWR meter units (**Photo B**). These units cover 1.8-60 MHz, 144 MHz and 440 MHz, for a price as low as $69.95. The MFJ-864 features separate HF and VHF/UHF directional couplers (the heart of most such meters), and each is equipped with its own SO-239 RF connectors. It has two power ranges, 30/300 watts forward, and 6/60 watts reflected. The MFJ-862 is a VHF/UHF version with the same power ranges, while the MFJ-860 covers on the 1.8 to 60 MHz bands.

MFJ offers their "one year no matter what" warranty on these units—given what some guys do to VSWR meters, that's pretty generous!

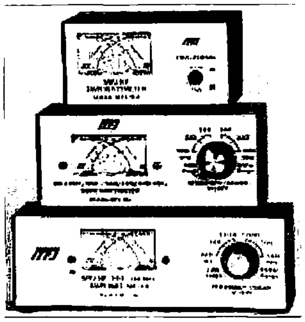

Photo B. MFJ-800-series RF wattmeter/VSWR meters.

Now for the nonsense

First, let me state flatly that I only respond to polite businesslike letters. The guy who, in December 1995, told me that my ancestry was suspect because I am a ham operator, didn't receive a reply...he's the same one who enlightened me with the blurb "...a 'ham' is half a pig's (yes, you know the word)." Sorry, dude, no cigar!

And the rest of the mailbag

I received two delayed letters on my series on vertical antennas. One of them asked whether the dimensions are the same for a ground-mounted quarter-wavelength vertical antenna as for a vertical antenna mounted on a tall pipe. The answer is: Not usually. As with so many things about antennas, the answer is a tentative "maybe yes, maybe no." I've put up a lot of verticals over the years: some of them were store-bought and some of them were homebrew. I've noticed that a slight variation in lengths is necessary, depending on where the antenna is mounted. I suspect that interaction with the local environment is the cause. But I've also noticed that the difference isn't always too great, and the resultant VSWR can be "tuned out" with a decent tuner. Still, install the vertical so you can adjust the lengths until the thing works right (Hint: Don't tighten the metal clamps until you finish adjusting it).

The other mailbag question about verticals arrived by Internet (see address below). The reader asked the value of the feed point impedance of the vertical. Again, the answer is a tentative "maybe...." The nominal impedance is 37 ohms (or as one purist chastised me, 36.6 ohms), and is therefore not a bad match for 52-ohm coaxial cable. But real verticals—you know, those messy things that we really have to put into or onto the air—are different. The feed point impedance will vary from a few ohms (like 2-3) up to the maximum. As a result, some companies offer multi-impedance broadband RF transformers that will help you match the actual impedance to 52-ohm coaxial cable. I've used the Palomar Engineers transformers, and have built 9:1 and 16:1 transformers following the directions given in the *ARRL Antenna Handbook*.

I've received several nice letters and E-mail messages on the twin-lead antenna discussed here a few months ago (and yes, the ends of the twin-lead *are* shorted!). Unfortunately, I didn't invent the antenna and can't take credit for it. I saw one for the first time in the late 1950s, late one night (actually, in the wee hours

of the morning) when a bunch of young hams went over to see a radio engineer from "Voice of America" who had just gone off duty. He told me that he'd found it in Bill Orr's (W6SAI) *Radio Handbook*. Bill, by the way, was my hero when I was a lot younger, and was the ham writer I most wanted to be like.

Connections...

I can be reached at P.O. Box 1099, Falls Church VA 22041, or via Internet E-mail at carrjj@aol.com. I am always glad to receive comments and requests, and will answer as many letters as I have time for...and that usually means all of them.

Number 41 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

"Young Ham of the Year"

In the spring of 1990, an event took place which was to be a highlight of my teaching career, as well as being a highlight in a student's life. Mary Alestra KB2IGG, a seventh grader at the time, won the "Young Ham of The Year" award.

"Mary's love of radio was obvious, and her dedication to helping other children was impressive."

Mary was one of the most articulate young adults who had ever come through my amateur radio program. Her love of radio was obvious, and her dedication to helping other children was impressive. She seemed like the perfect choice to nominate for the award. The entire school took pride in her nomination. You can imagine how excited we all were when Mary was notified that she had won.

When a youngster receives national recognition, it has a big impact on his or her life. As you read about the qualifications for this award think about deserving young people you might want to nominate.

The "Young Ham of The Year" Award program was conceived in 1985 by then *Westlink Report* newsletter Editor-in-Chief Bill Pasternak WA6ITF. His desire was (and still is) to highlight the accomplishments of the nation's many young radio hobbyists, and to encourage the involvement of more young people in the exciting, rewarding hobby of amateur radio.

Corporate underwriting for this award program is traditionally supplied by Yaesu U.S.A. Corporation and *CQ Magazine*. This year the youngster who is chosen as 1996 "Young Ham of The Year" will get the chance to know what it's like to train to become an astronaut. The winner will be treated to Spacecamp in Huntsville, Alabama, in addition to other prizes supplied by Yaesu U.S.A. and *Newsline*. *CQ* publisher Richard Ross K2MGA says, "As we enter our second year as co-sponsor of this award program, we are expanding our participation to include a week at Spacecamp. Our nation has a growing need for well-trained scientists and engineers; even if they don't become astronauts, the Spacecamp experience can help young people get started towards technical careers."

The young winner will also receive an expense-paid trip to the Huntsville Hamfest, where the award plaque will be presented at the Grand Banquet, along with a special prize in the form of ham radio equipment. The trip and the radio are courtesy of Yaesu, and the plaque is provided by *Newsline*.

The "Young Ham of The Year" award is presented annually to a United States licensed ham who is 18 years of age or younger and who has provided outstanding service to the nation, his/her community, or the betterment of the state of the art in communications through amateur radio.

All nominations must be submitted before June 30, 1996, on an official application form. Applications are available by sending a self-addressed stamped envelope to: The 1996 "Young Ham of The Year" Award c/o *Newsline*, 28197 Robin Avenue, Saugus, California 91350. The nominating applications are also available for electronic download from several sites that provide *Newsline* materials over the World Wide Web and from the general interest ham radio files area on America On Line (AOL Ham Radio Club BBS-Software Exchange-General Interest Files).

Bill and I agree that the real spirit of this wonderful award is to highlight a young person who has done more than just pass a license exam. We're always on the lookout for the young adult dedicated to the fellowship and service that is vital to the preservation of amateur radio. Good luck with your nominations.

For more information contact: Bill Pasternak (805) 296-7180.

Make a MICOR Into a Repeater

A simple modification using a popular mobile radio.

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ambrookes@aol.com

After our club had a few repeater failures we ended up using two Kenwood mobile rigs as the repeater, one as the receiver and the other as the transmitter. Ham mobile rigs can do just fine as repeaters in a quiet RF environment with a good duplexer, but mobile rigs aren't really designed for heavy-duty repeater applications or for use at a high RF level repeater site. We were looking for replacement equipment when we spotted an ad by Versatel Communications in this magazine. They were advertising $99 Motorola MICOR 45 watt mobile radios which could be converted into repeaters, so we called for further information.

I talked with Versatel's head technician and everything sounded pretty good, so we took the plunge. To save time, and since we didn't have a Motorola test set handy, we ordered the radio with crystals installed and tuned, the repeater conversion instruction manual, and a conversion parts kit. All we would have to do were a few minor wiring modifications. The total cost with our options and shipping was less than $200.

The radio arrived in a month, with all items as advertised. After reading the instructions through a couple of times, we were ready to begin surgery. The modifications required were: (1) modifying the receiver RF connection; (2) strapping the receiver and transmitter channel selection (the control head would normally do this); (3) adding a small perf board with a couple of pots to act as a substitute volume and squelch control (again, the control head would normally do this); (4) minor modifications to the radio's power switching circuitry to allow full duplex operation; (5) interface to a controller (bringing the mike, PTT, receiver audio and COS signals out via a cable or connector).

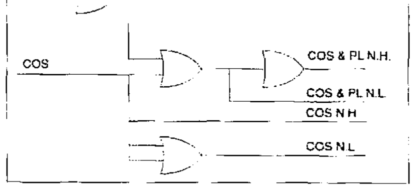


Fig. 1. The CMOS gate wiring.

"The transmitter strip is well-suited for ham repeater operation, as the whole transmitter side of the radio is an extruded heat sink."

Photo A shows the mobile rig with the top cover removed, as viewed from the rear. As you can see, it is assembled with modules; the transmitter strip is on the left side, the interface and connector board is the narrow strip in the center, and the receiver is on the right side. Each module has an RF shield (except for the one which we removed during modification of the audio/squelch board and lost). The SO-239 bulkhead connectors, Cinch-Jones power connector, and DB-9 controller interface connector are our modifications on the rear panel.

The transmitter strip is well-suited for ham repeater operation, as the whole transmitter side of the radio is an extruded heat sink. Although the transmitter is rated at 45 watts, we planned to run only about 25 watts, so there should be plenty of margin for repeater duty, especially when adding an external cooling fan as we have done.

Since the radio is a mobile unit, it normally switches the antenna connection between receiver and transmitter through a relay. Part of the conversion to make the radio full duplex is bringing out the transmitter and receiver antenna connections to individual connectors. Versatel's instructions call for the receiver RF connection to be brought to the rear panel, with the transmitter still using the existing relay for the transmitter connection (which is at the front of the radio).

Photo B shows the bottom of the radio viewed from the front. We made some changes in Versatel's suggested wiring. This photo shows that our modifications brought out both the receiver and transmitter antenna connections to the rear panel, along with the power and controller interface connectors. The radio's original antenna connection can be seen at the very left front of the radio, with the key lock just to the right of the connector. We disconnected the DC wiring to the antenna relay to save a little power, since the relay is now unused. To bring out the transmitter connection you will need an RCA jack and a piece of coax (RG-58 or similar) appropriate for the transmitter power level. Unscrew the output filter assembly located at the front top of the transmitter strip (it's labeled TFD6101A in the lower left-hand corner, in **Photo B**) to route the cable and RCA plug to the transmitter output jack, then reconnect the filter.

The radio we received had some

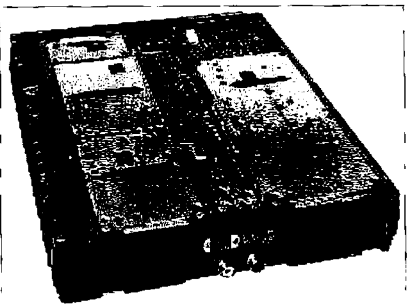


Photo A. Top cover removed.

surface corrosion along the rear panel. This was not unexpected for something that may have spent the last 10 or 15 years in the trunk of a taxi cab or a truck. A little sandblasting and paint made the panel look like new. We then used a punch to form the RF bulkhead connector holes, and a nibbler tool to make the openings for the power connector and DB-9 connector.

The modifications, suggested by Versatel, also call for an audio/squelch pot board to be installed in the radio; normally a control head would provide these functions. In **Photo A** you can see the small piece of perf board and the components at the far top end, mounted with double-sided tape to the radio's interconnection board. Also, a speaker load resistor is visible slightly to the right of the perf board. **Photo C** shows the detail of these two items. In **Photo B**, a small Radio Shack™ speaker is double-sided taped to a metal divider inside the audio/squelch compartment.

Versatel's instruction manual shows the COS signal to the repeater controller being picked from their "Point H" (pin 12 of the audio/squelch board connector), but this is the output of an analog detector and is not a clean logic signal. I recommend taking the COS from pin 10 of IC202. The instruction manual supplied by Versatel is good from a modular level, but there is not enough detail for this mod to be made unless you have a complete manual. For those who don't have and can't find one, IC202 is one of only two chips on the audio/squelch board, and it is the one located closest to the interface connector pins. Pin 10 of IC202 is also routed to pin 8 of the interface connector pins, and our wiring to that pin can be seen in **Photo C**. The COS signal at this point is 0 volts unsquelched and 6.9 volts squelched.

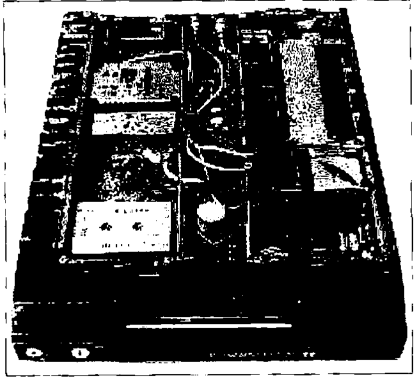


Photo B. And here's the bottom. The messy part is our added wiring.

In addition to bringing the COS signal out to the controller interface connector, we also added a Motorola PL (CTCSS) decoder, and routed the PL decoder detector output along with the COS signal to a CMOS 4001 gate. The gate is wired as shown in **Fig. 1**, and provides us with the ability on the interface connector to use any of three squelch signals for the controller: COS only, PL only, or COS and PL ANDed from the 4001. And, with the single 4001 chip, any squelch signal can be either normally high or low.

Why would we use PL and COS ANDed? This radio uses resonant reeds to detect the CTCSS signal. These reeds have both a start-up decode delay time and a shutdown delay time. By anding the PL and COS, the shutdown delay time is eliminated from the composite signal.

Photo D shows the 4001 attached with double-sided tape and the nest of wires attached to it. Pin 7 of the chip is bent over and soldered to the small lug rising through the PC board, and pin 14 is folded over and soldered to the trace marked as REG+ on the board. The PL decoder output is picked off from pin 3 of the PL board, which would be the third in-line pin closest to the audio amplifier connections of the audio/squelch board. If you have the PL board, you'll know where to connect from this.

Alternate wiring

You can order these radios with a control head and cable. All of the modifications except RF cable routing and duplex power switching can be performed inside the control head, or you can discard the control head and just use

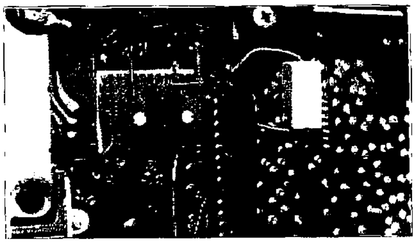


Photo C. The audio/squelch board we added. This is normally in the control head.

the appropriate wires from the control head's cable for controller interfacing.

If your controller requires switched audio, then you could accomplish this several ways. The COS from where we took it provides a clean logic level which can be used to drive an analog gate or (gulp!) a relay. The Motorola audio/squelch board in the MICOR includes squelch driven shunt switches inside IC202 that could also be used to ground the low level audio. A full manual would be handy for this mod.

Summary

What we got from Versatel was exactly as advertised. The rig was crystalled and tuned and the instructions were simple and clear. The radio has worked fine from its first day of installation.

On the downside, the included schematics are a little hard to read in some places, and a better copier or non-reduced copy from Versatel would help. It would also be nice to have more schematics of the circuitry itself. Then again, if we looked hard enough we could probably get a manual from a local radio shop.

Overall, we would rate Versatel's conversion package an eight out of 10. The Motorola MICOR mobile makes a great repeater, and for a couple of hundred bucks, you just can't go wrong. If you have a MICOR from another source, Versatel will also sell the conversion instructions alone. 73

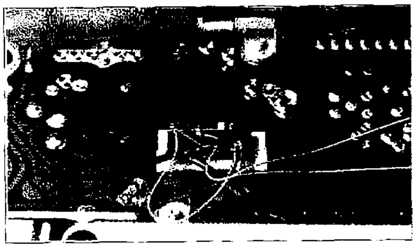


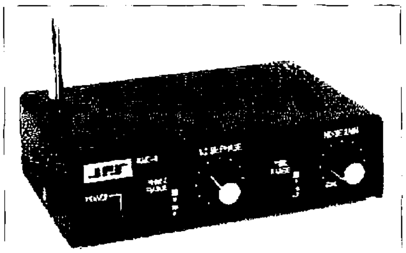
Photo D. CTSS CMOS gate.

Number 44 on your Feedback card

73 Review

The ANC-4 Antenna Noise Canceller from JPS

Reduce that noise!



Pete Ferrand WB2QLL
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pferrand@scoot.netis.com

The use of phasing to get rid of noise is common with microphones. The ANC-4 uses the phasing technique to get rid of noise before it gets to the antenna input of your radio. It's not an audio filter or a digital signal processor. The ANC-4 is connected between your normal antenna and your transceiver or receiver. Thus, when the ANC-4 knocks out noise, the noise never gets into your radio, so the receiving circuits have less to do and aren't overwhelmed by all that noise. The ANC-4 does its phasing by using a separate antenna to pick up the noise; that signal cancels out the noise you're listening to from your regular antenna.

First, set up the ANC-4 so the noise is picked up at the same or greater level from its noise antenna as it is with your regular antenna. Second, adjust the ANC-4's phasing controls until the noise disappears. If the noise doesn't null out, use the "phase range" and "freq range" buttons to increase the range of the phase shifter network.

The "gain" and "phase" controls interact some, so it's a good idea to watch the radio's S-meter closely and set the radio AGC to "fast." It's not a hair-trigger adjustment and the noise null increases smoothly as you approach the correct point. Settings will normally not need to be changed as you tune across the band, but they will need to be changed if the noise changes.

"I was able to get 40 dB of noise reduction on computers, broken streetlights, and power line noise."

How does it work? Simple—the noise signals from both antennas are combined. Your adjustments have caused these two signals to have equal amplitude and opposite polarity (a 180-degree phase difference). Some types of noise are easier to cancel than others. The unit is designed to deal with locally generated noise, since all noises present constantly changing phase relationships when propagated over a distance.

The other requirement is that the noise antenna must hear the noise. The ANC-4 is provided with a telescoping whip, which works fine for most power line and computer noises you may have around the house. If the noise that bothers you can't be heard on the whip, there's a phono plug in the rear for attaching another antenna which can be positioned so it does pick up the noise. This may be a wire run into the engine compartment, if you're trying to defeat mobile ignition noise, or an outside dipole with polarization adjustable to match the noise, or perhaps a wire running parallel to your shack's power lines.

I was able to get 40 dB of noise reduction on computers, broken streetlights, and power line noise—including line noise hereabouts that sometimes wipes out an FM broadcast station a mile away. It also works on household stuff like light dimmers, microwave ovens, and TV set horizontal oscillators. By careful operation, it's also possible to null local radio transmitters, such as broadcast stations.

You can't get rid of any signal subject to multiple modes of propagation. That basically means signals beyond ground wave. I discovered that some local noises change. For instance, a video monitor's signal can be perfectly nulled, only to have the noise reappear when the image on the monitor changes. You can only null one single noise at a time. I found that getting rid of the loudest noise source makes it easier to hear other noises! Discouraging, but that's life and those noises were there screwing up my listening pleasure anyway. Of course, I could get a second ANC-4...

Other features include an internal switch that bypasses the unit automatically when you transmit through it, so you can use it with a transceiver as long as it puts out 150 watts PEP or less. If you use a linear, simply locate the ANC-4 in the antenna line between the linear and transceiver. Lastly, by using just the noise amp and the whip, with no main antenna, you can use it as an active antenna.

My conclusion is that the ANC-4 is definitely worth having if you have noise problems. It is not a replacement for an audio filter or a DSP unit—absolutely not. To deal with heterodynes, band noise, static crashes, and adjacent signal splatter you need DSP and audio filtering.

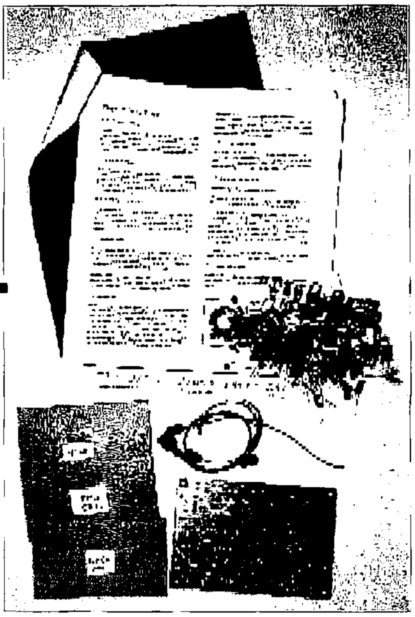
The times I'm most grateful for the ANC-4 are when I'm listening to my receiver, something starts up down the street and the S-meter swings over 20 over 9...a few adjustments to the ANC-4 and I can hear the station again. The ANC-4 ($176 retail) is manufactured by JPS Communications, P.O. Box 97757, Raleigh NC 27624. Telephone (919) 790-1048, (800) 533-3819 or FAX (919) 790-1456.

73 Review

The Green Mountain GM-20 QRP

Another small wonder!

Marshall G. Emm AAØXI/VK5FN
2460 S. Moline Way
Aurora CO 80014



One of the attractions of QRP operation (5 watts of RF power or less) is the wealth of excellent equipment that is available in kit form, at reasonable prices. The latest super rig may have more bells and whistles than the theater organ at Radio City Music Hall, but it will cost as much as a large car or a small house. Meanwhile, if you are prepared to avoid causing QRM and TVI and accept the challenge and excitement of QRP operating, there are some excellent single-band CW transceiver kits available for less than $100!

A steady stream of new QRP kit rigs has appeared over the last few years, so when a new one is announced by one of the Godfathers of QRP design, it gets a lot of attention. Such is the case with Dave Benson's (NN1G) new Green Mountain single-band CW transceivers for 40, 30, 20, 17, and 15 meters.

The Green Mountain series is a "lateral descendent" of the Small Wonder (or "40-40") series and the NN1G Mark III ('95 *ARRL Handbook*) transceivers. The main distinguishing feature in the new line is a separate heterodyne local oscillator, which adds a bit of complexity, but really helps on the higher bands. The transmitter drive has been beefed up with an MMIC embedded in the bandpass filter, providing 12 dB gain to the driver, and the final output is adjustable from 0.5W to a solid 3W. In the 20 meter version, the second harmonic is down 34 dB and spurs are down about 50 dB, at full power. Now that's *clean!*

The rig also features full break-in (QSK) via the familiar FET switch popularized by W7EL, and the receiver has incremental tuning (RIT) via a quad analog switching IC. A four-pole crystal filter on the 8 MHz IF sets the received bandwidth at 700-800 Hz.

Apart from the separate LO section, the receiver and audio output sections are pretty much standard for QRP rigs, but with an MC1350 IF amp providing 30 dB gain and a high level of stability. Sensitivity is right up there with the big rigs; minimum detectable signal is quoted at .1 μV (-126 dBm), and, in practice, you're limited to the ambient atmospheric RF noise level. These are *hot* little receivers!

> ***"The instructions for winding the 13 toroids, often a real bugbear for kit builders, are some of the best I've seen."***

It's available as a board kit (printed circuit board, all board-mounted parts, and instruction manual) for $75 postpaid, so you get the fun of building a well-designed kit which, after an hour or so, you'll turn into a real fun machine.

Construction

Your first pleasant surprise comes when you open the package from Small Wonder. The board is nicely done, double-sided and solder-masked, and the components are all new and of high quality. Several small groups of components are packaged in separate envelopes to avoid confusion, and the manual is a pleasure to read.

Small Wonder's philosophy is to encourage you to understand what you are doing. The manual includes a detailed description of the circuit components and trouble-shooting instructions, but it does assume a reasonable level of skill on your part. You don't get step-by-step Heathkit-like instructions telling you how to identify a 2.2k resistor and where to put it; the instruction steps are things like, "Install all of the board mounted components for the Local Oscillator as per the diagram below," or, "Wind and install all of the toroids in accordance with Table 1." For most of us, that's plenty. The silk-screened parts overlay on the circuit board and the parts list are all you should need and you can do it in whatever order suits you. However, the tips shown in the sidebar may be helpful and the instructions for winding the *13* toroids, often a real bugbear for kit builders, are some of the best I've seen.

An interesting approach is to have you build, test, and partially align the heterodyne local oscillator stage first. RF voltages are measured with an oscilloscope, but if you don't have one you can open the supplied "test circuit" envelope and build yourself an RF probe for your digital voltmeter. Getting this stage built and aligned insures that you are on the right track with your soldering techniques, and gives you a known starting point for the final testing and alignment.

This is a board kit, but turning the finished board into a finished rig in a box isn't difficult. All off-board connections (except a short link of coaxial cable for the antenna) are made via pin connectors. The wiring harness, with mating connectors already wired and color-coded, is provided in the kit.

Alignment and testing

You'll need some additional components in order to wire up the board for alignment and testing. They're available at your local Radio Shack™ or from any mail order parts house. and should set you back about 10 to 15 dollars. not counting the box:

- 10k gain pot (audio taper)
- 100k main tuning pot
- 5k RIT pot
- SPST RIT switch
- Key jack (RCA or 1/4")
- Headphone jack (2.5mm or 1/4", your choice)
- Antenna jack (SO239 or BNC)
- A power connector (and .75A fuse)

I used a combination audio gain pot and power switch, and connected a power-on LED. I also used a DPDT switch for the RIT so I could switch 12V to an RIT-on LED. For power, I run red and black wires through a grommeted hole to a Molex-type connector (RS 274-222) via an in-line fuse holder (in the positive line). It's a good idea to wire everything up on the bench so you can test and align the rig before locking it up in a box. The use of the wiring connectors makes this very easy to do.

The alignment is relatively straightforward and you will need only two or three items of test equipment: a general coverage receiver, an HF transceiver, and some means of measuring power output. My rig came into alignment very easily, and went right to the rated output of 3 watts. The sidetone is a sampling of the RF output, so its pitch is a direct representation of the transmit offset and there is no adjustment necessary. The VFO range turned out to be approximately 85 kHz, down a bit from the rated 100 kHz, but within the tolerance of the varicap.

The GM-20 on air

The first thing you discover when you take your GM-20 into the real world is that the receiver is *sensitive*. It is every bit as sensitive as the big rigs and has adequate selectivity. The filter skirts are steep, and although you may prefer a narrower bandwidth, you can usually use the RIT to throw an unwanted signal out of the passband. A variable bandwidth filter would be nice, but there are enough inexpensive external audio filter kits around so that it really isn't necessary.

The keying is clean and precise, and the sidetone is pleasant to listen to. There is no apparent drift, and the QSK function is very smooth.

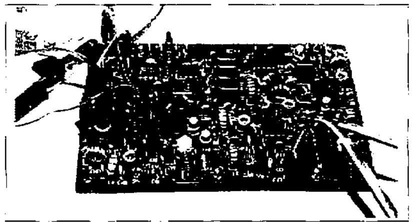
It's always a thrill to make that first QSO with a new rig, especially when the other station is on the other side of the continent, also running QRP, and gives you a good signal report. Say what you like about solar minima, but there is some real truth in the QRPer's motto: "Skill, not power!"

Conclusion

The Green Mountain series represents a terrific value for the money, and the rigs are great fun to use. Watch out—QRP is addictive! It's probably not a good kit for a beginner, but if you have at least intermediate kit building skills you will find that it's easy, and you will have the added benefit of knowing that you really built something!

The Green Mountain transceiver kits comprising circuit board and all board-mounted components are available from: Small Wonder Labs, 80 E. Robbins Ave., Newington CT 06111; (203)-667-3536.

Note from the Big Cheese: *If you build one of these rigs please let me know what fun you've had with it after a few days on the air. I want to know, and if you've made any really interesting contacts, the readers will be interested too. Wayne*



Tricks of the Trade

(1) Never buy a kit from someone who doesn't offer to fix it if you are unable to get it going.

(2) Read the manual! They all say that, but it's surprising how often a problem could have been avoided if you had just read through the darn book first. Those corrections at the end of the manual can cause a lot of grief.

(3) If a copy of the circuit board layout is not provided in the manual, *make* one. Just photocopy the board, both sides. The copy of the component side is useful if component labeling is covered up by the components. A copy of the foil (soldering) side will be invaluable if you have to track down solder bridges; often it is impossible to see whether two points should be connected without referring to the artwork or a photocopy.

(4) If the foil (soldering) side of the board is dirty, or if you got your fingerprints on it while you were photocopying it, clean it with alcohol before you start soldering.

(5) Sort the components and check them off against the parts list before you start soldering. If you find a wrong or missing component, you may be able to get it replaced before you need it, or at least minimize the delay.

(6) If you have any doubts about your soldering skills, do some practice work with junk components and then get a local ham to check your work.

(7) Solder under a magnifying glass. A magnifying desk lamp is the best bet, but a "helping hands" device with a magnifier will do.

(8) Check *every* joint under magnification *as you do it*. Be especially careful to watch for solder flowing onto adjacent tracks or pads.

(9) Keep some desoldering braid handy and fix those mistakes immediately. Don't make a mental note to come back and correct later.

(10) Do no more than 5 or 6 components at a time. Where two component leads share a solder pad, do them both at the same time so you don't solder over an empty hole. Often there is a good reason for the order shown in the manual.

(11) There are two exceptions, regardless of what the manual says: (A) Do the IC sockets first. If nothing else is on the board you can just turn it over and solder without worrying about holding the things in place. (B) Do the toroids next. These are often problem spots, and if nothing else is on the board you can easily use your multimeter to check continuity between the pads, insuring a good joint and continuous coil.

(12) In general, do the smaller components (and those that mount flat to the board) first; larger ones last. Otherwise you may have trouble getting to the holes.

(13) Once you have finished mounting board components, clean the excess flux from the foil side of the board using a commercial flux remover or acetone (be sure to do this in a well-ventilated area and heed the precautions on the solvent container). A clean board is *much* easier to troubleshoot. Look over the joints and reheat any that do not look right.

(14) Before applying power for the first time, double-check that all components are in the right places and have the correct polarity. If you are too lazy to check everything, at *least* check all diodes, electrolytic capacitors, and integrated circuit chips.

(15) When you first apply power, look carefully for any signs of smoke! You may be able to detect a hot spot or a component turning brown in time to disconnect the power and find the problem. If you can, you might also hook an ammeter in series with your power supply so if the meter shows more current than expected you can turn the power off!

(16) Bench-wire all external controls and connectors so that you can test and align *before* you get the circuit board screwed down in a box.

(17) If you do have to send it back, ask for a description of what was wrong with it so you can avoid that problem next time.

Number 48 on your Feedback card

73 Review

The Carolina Bug Katcher Multiband HF Mobile Antenna

Jeff Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

Any mobile antenna is a compromise. I wanted one that would allow me to operate on several bands, but without my having to carry around resonators for each band. One that fit the bill was the Carolina Bug Katcher by Lakeview, the makers of the Ham Stick single-band antennas.

The Bug Katcher sells for $89.50, which makes it one of the least expensive multiband mobile antennas. It provides continuous coverage of all amateur, Mars, and marine bands from 7 to 31 MHz. The Hi Q coil gives 1 to 2 S-unit improvement over the Ham Stick's. The antenna is 7.5 feet long and stores in a 50-inch-long space.

Setup

To set up the antenna I put little clips on the coil and then used an MFJ Antenna Analyzer to measure the SWR for each band I wanted to set up (see **Table 1**). Once I had the bands set up it was a matter of just switching a quick disconnect clip from one of these set points to another to change bands. Yes, I have to get out of the car, but it only takes a few seconds to switch bands.

Fitting the antenna mount to the car was the most difficult part for me. The main function of the mount is to provide mechanical stability and support, since going down the road at 65 mph places a significant wind load on the antenna. The second function of the mount is to provide a good ground.

"I wanted a mobile antenna that would allow me to operate on several bands, but without the need for resonators for each band; the Carolina Bug Katcher fit the bill."

In today's automobiles you can't assume that a trunk lid or bumper is grounded, so it's a good idea to use an ohmmeter to check for a low resistance path (less than 25 ohms) between the grounded portion of the mount and the negative pole of your car battery. Or you can use a magnetic mount on the roof, which provides a nice ground plane effect.

Mobile antennas work best when they're high and in the clear. Some hams drill a hole in the car roof to mount the antenna. While this is probably the ideal installation, there are a few hams who are unwilling to drill holes in the roofs of their cars! I'm one of the latter, so I use the Lakeview Quad Magnet mount ($49.95) on my mini-van. I just stick it on the roof, thread the coax through the door, and I'm ready to go. I have to watch it going under low tree limbs and through parking garages. Although I have used this setup with the Bug Katcher, I feel a lot more comfortable using a heavy duty split ball mount. I used the one from Lakeview ($21.95 cat #075) on my other vehicle and haven't had any problems.

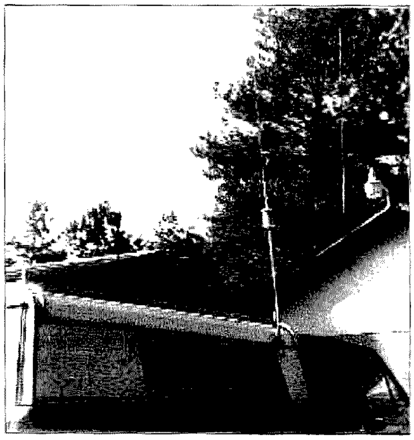


Photo A. The Carolina Bug Katcher mobile antenna from Lakeview Co.

Operation

After I finished setting up the Carolina Bug Katcher on my car, I turned on the rig and tuned around on 20 meters. I heard Dale WA7KYT operating a Special Events Station on the West Coast. He was a 57 and gave me a 55. Considering he was on a directional antenna and I was on a mobile antenna, I sure couldn't complain. I next talked to OE6T, who was working an SSB contest.Once again I didn't have any trouble at all making or maintaining contact. I have used the Bug Katcher on both CW and SSB with a great deal of success.

You can get more information from Lakeview Co., Inc., 3620-9A Whitehall Rd., Anderson SC 29624. Telephone (803) 226-6990 or FAX (803) 225-4565.

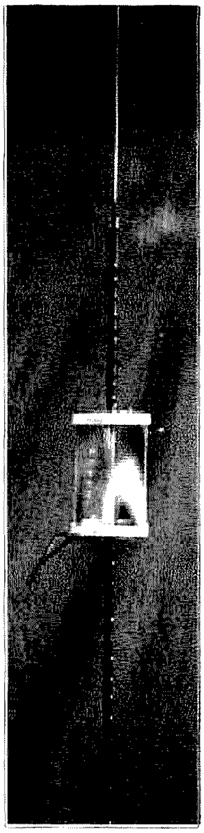


Photo B. The Bug Katcher at work.

BAND	BAND WIDTH-2:1 SWR POINTS
40 meters	30 KC
30 meters	all
20 meters	250 KC
17 meters	all
15 meters	400 KC
12 meters	all
11 meters	entire band
10 meters	800 KC

Table 1. SWR figures for each band setup.

Economical High Current Power Supply

A "smart" battery charging system to build.

William Jacobs WA8YCG
Route 1, Box 212
Independence WV 26374

It was a dark and stormy night...well, it was. A blizzard caused a power failure, and it got very dark and very quiet very fast. The setup I use to keep the battery in my Field Day camper charged came in *very* handy—I was able to put my HF radio back on the air. In fact, it worked so well I now use it as a power supply.

With this circuit and a small 800 mA wall transformer, I've been able to forget maintenance on the battery over the winter. The battery (a regular auto battery, not a deep-cycle) is 4 years old and has not degraded appreciably.

Why it works

Most new transceivers use 12 volt direct current for operation. Getting the high current necessary for transmitter operation requires an expensive power supply. Here is a way to reduce this cost as much as possible.

Modern transceivers require 12 volts at 1 or 2 amps for receive operation. This is not a difficulty. A well filtered, well regulated 3 amp power supply will sell for less than $25 new from a radio supplier and even less, used, from a flea market. The high current problem starts when transmit operation begins. When in the transmit mode, current consumption of a 100-watt rig could exceed 20 amps. This high current demand lasts only a short time but it is real and must be serviced. Knowing how much power must be made available for transceiver operation can be analyzed in a limited manner.

Let's consider a CW QSO. The on/off operation of a CW signal produces a duty cycle of just a little more than 50%. Since transmit/receive is about even—we listen as much as we talk—this theoretical CW QSO is about 25% key-down transmit and 75% key-up receive. This would imply that the long-term (over the total QSO) current consumption of a CW transceiver requiring 20 amps key down will be only 5 amp hours for each hour of transmitting time and 1 or 2 amp hours for receive. The total would be 6.5 amp hours (25% of 20 + 75% of 2).

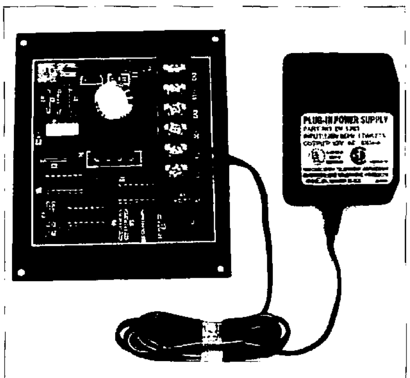


Photo A. The completed power supply unit. (Photo by John Jacobs, Independence WV 26374.)

When this transceiver is operated from an automobile, we supply high current from the auto storage battery and replace the power with the car's charging circuit. It is not necessary to have the charging system supply the high transmit current. It is entirely possible that with lights, air conditioner, fan, and windshield wipers on, the charging system will not be able to meet the demand. It will, however, be able to replace some of the energy used, little by little, as we motor down the highway. If this same type of operation could be used at home, the average current draw would be supplied by the much smaller, more economical power supply, and peak current would be supplied by a battery and a battery charging system.

How it works

A storage battery is used as a reserve for the high current operation requirement and is recharged with a small low cost, low current "smart" battery charging system that can be left on indefinitely without harming the battery.

> ***"It's a small low-cost, low-current 'smart' battery charging system that can be left on indefinitely without harming the battery."***

The project is built in five systems. The first system, "the smarts," senses battery voltage. The second, a logic circuit, provides switching signals. The third is an oscillator, used as an AC-to-DC converter. The fourth is the power FET or switch and the driving circuit, and the last is a power conditioning circuit.

The smarts of the charging system come from monitoring the battery voltage to keep the battery at or near full charge. The circuit operation is as follows. Battery voltage is divided by resistors R3, R4, and R7 and fed to comparator U3A and U3B. U3, an LM339, is a quad (four devices on one chip) voltage comparator. The output of comparator U3B is set to go low when battery voltage is above 13.5 to 14.0 volts. This voltage is the "Turn Off" signal of the charging system. When the battery

voltage reaches this point, charging ceases. The output of comparator U3A is set to go low when battery voltage is below 13.0 to 13.5 volts. This is the "Turn On" signal of the charging system. When the battery voltage is below this point, charging commences. When battery voltage is below "On," the system will be on and when the battery voltage is above "Off," the system will be off.

These two signals are connected to U1, a 4011, a quad 2 input NAND gate. U1A and U1B form the logic circuit. These two NAND gates latch the charging circuit on until the "Off" signal is reached and keep it off until the "On" signal is reached. This hysteresis of 1/2 to 1 volt keeps the circuit from turning on and off at microsecond rates. In normal operation, the charging circuit may stay off for as long as 20 seconds. In some cases, depending on battery age, capacity, and condition, it could look as if the battery voltage were being held at the "Turn On" voltage. Actually, the voltage rise of the battery is so fast that it looks like current is continuous. This can be verified with an oscilloscope. This will taper off in time. The switching action prolongs battery life by keeping the battery from gassing. Battery gassing is destructive to the battery and requires more maintenance. The output of the logic circuit (Drive) goes to an oscillator.

U2 is a 4047 IC oscillator with an operating frequency of about 2500 Hz. It is turned on with the signal from the logic circuit (Drive). It is used to make alternating current from direct current The alternating current is rectified and used to drive the gate of the power FET. The AC output of this oscillator is coupled to T1, a simple interstage transformer, through capacitor C2. The output of T1 is rectified and applied to the gate of Q1. This voltage has reference to the source terminal of Q1, and produces a positive 12 volts added to the battery voltage without regard to battery voltages. This high voltage (about 25 volts) feeds the gate of Q1 which connect the battery charging voltage to the battery. Q1 is a power field effect transistors that will have a very low resistance when turned on. The junction resistance of the transistor goes down markedly when the gate voltage is increased. However it must be kept lower than the breakdown voltage of the gate. On the specified transistor this is 20 volts. Even with the low resistance, the transistor may get warm and should be fastened to a heat sink if current of more than 2 or 3 amps is supplied. The power conditioner is a full-wave bridge rectifier, filter capacitor and regulator circuit.

Make it work

The circuit board makes construction very easy. All parts except the power transformer are mounted directly to the board. Construction time should average about one hour. Start with the resistors, capacitors (with the exception of the electrolytic capacitor), diodes (observe polarity), terminal strip, transformer, voltage regulator, the power FET, and all the ICs. Sockets for the ICs are not necessary and cost more than the ICs. The electrolytic capacitor is large and should be installed last.

The resistors in the voltage divider circuits were 1% precision resistors on the first few chargers that I built. I have found however, that the precision is not necessary. The range of the "Turn On/ Turn Off" voltages are not at all critical so the 1% precision resistors are not needed. I have since used 5% resistors and they work just fine. This no-adjustment approach removes lots of unnecessary fussing. The voltage "ON" and "OFF" values may be different from their intended values of 13.0 and 14.0 volts but the difference will be inconsequential to the operation of the power supply. As long as turn off is 14.2 volts or lower, and turn on is above 12.8 volts, appropriate operation will result.

Any power transformer with output of 12 volts AC will power the system. The bridge rectifier diode I specified is rated at only 4 amps and the capacitor has a working voltage of 25 volts. These are the limits placed on the transformer. I have found that a small wall transformer rated at 12 volts AC 800 mA will

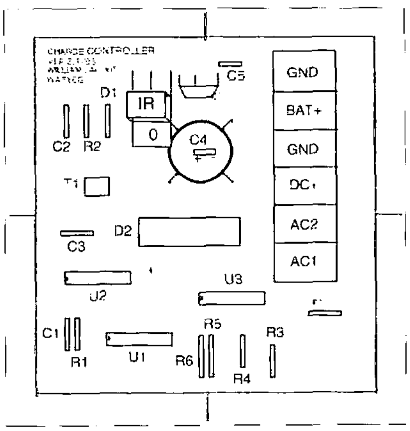


Fig. 2. Silk-screen pattern.

keep my 100-watt HF station running for more than 3 hours a night and be ready to go again the next night. A 3.5-amp wall charger would recharge the battery completely in about one hour for each hour of actual operation. Depending on the radio, the bigger transformer may cause some hum.

There are no blinky lights on this project. Intentionally. Operation can be checked with a voltmeter and once proper operation is verified, the power supply will be relegated to the floor under the table. No further thought will be given to it.

All that's left to do now is to connect a battery, rig, and the charge controller together and have fun. The use of a covered plastic marine battery box is recommended. If a scrap of wire should happen to come in contact with the

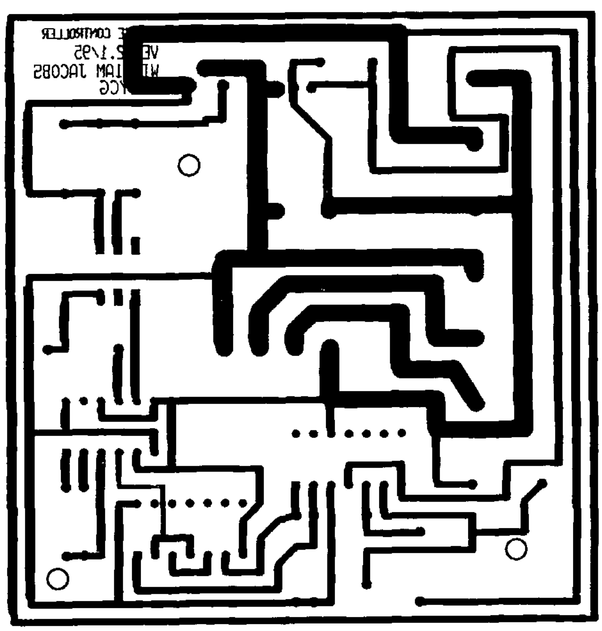


Fig 1. PC Pattern from the top of the board. When the board is printed, the text will be "correct reading."

battery terminals, the energy stored in the fully charged battery will be turned to heat—absolutely spectacular! Avoid it!

In operation the battery voltage will fluctuate between approximately 13.0 and 14.0 volts. This can be easily observed with a digital voltmeter. The voltage fluctuation may be hard to see on a 50-volt scale of an analog meter. It will, however, be easy to see the charge current switch on and off as the circuit maintains the full charge of the battery.

This circuit will also work with a solar panel. There is no blocking diode so the charger uses power all the time. The drain on the battery is about 10 mA. A good blocking diode would eliminate this. Before you add it, considering the following: The average night is 12 hours. 12 hours times 10 mA is 120 mA-hours. Charging at 1 amp the battery drain will be restored in 7.2 minutes. I feel it is better to lose the 10 mA than to limit the maximum charge by the diode-caused voltage drop. If your panel has more loss, you may want to use a diode between the panel and the charge controller.

I have built several of these circuits and have a printed circuit board. Friends have also built the circuit for about $20 plus the wall transformer. If my little project intrigues you and you want a board or all the parts drop me a line.

Parts List

Name	Number	Value	Mfg.
4011	U1	4011	
CD4047	U2	4047	
LM339	U3	LM339	
Capacitor	C1	.01 µF disc	
Capacitor	C2	.01 µF disc	
Capacitor	C3	.01 uF disc	
Capacitor	C4	4700/25V	Xicon XRL25V4700
Capacitor	C5	.01 µF disc	
Diode	D1	1N4001	
Full Wave Bridge	D2	TL402	TCI
Terminal Strip	J1	NC6-P107-06	Augat
Resistor	R1	10k 1/4 watt 5% carbon	
Resistor	R2	1 m 1/4 watt 5% carbon	
Resistor	R3	4.7 k 1/4 watt 5% carbon	
Resistor	R4	750 1/4 watt 5% carbon	
Resistor	R5	20K 1/4 watt 5% carbon	
Resistor	R6	20K 1/4 watt 5% carbon	
Resistor	R7	10K 1/4 watt 5% carbon	
N Pwr FET	Q1	IRF531	IRF
Volt Reg	Q2	10V reg	ECL 78L10BP
Transformer	T1	TL009	Mouser

All parts are available from Mouser Electronics, 12 Every Ave., Randolph NJ 07869 (800) 346-6873.

PC boards are available from the author for $6.00. A PC board and all parts with the exception of the wall transformer are available for $22.00. A small project box is available for $5.00. Please add $2.00 to all orders to help with shipping.

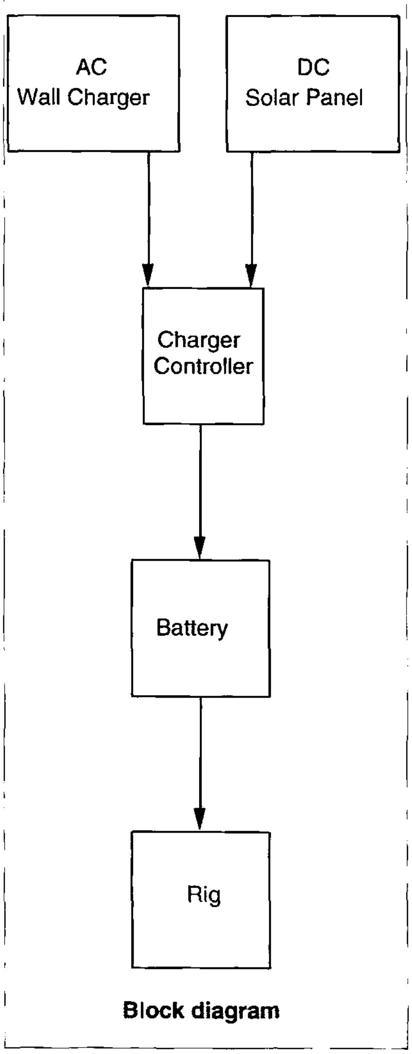


Fig. 3. Block diagram showing solar panel, AC wall transformer, charge controller, battery and rig.

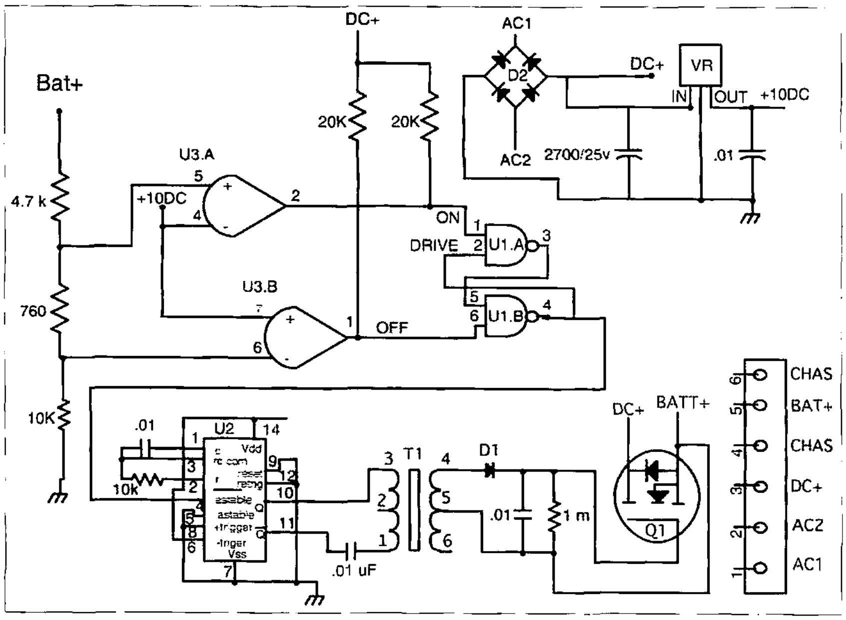


Fig. 4. Charge controller schematic.

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92633

Talking T's and Hidden Repeaters

"The T is on the air!" That announcement is sure to give an adrenaline surge to everyone at the starting point of a mobile hidden transmitter hunt. When you start out on a T-hunt, as these radio direction finding (RDF) contests are called, you never know where you'll end up and you don't know what you'll find there. No wonder most hams who try T-hunting get hooked on it.

With high-gain quads, Doppler sets, and other state-of-the-art RDF equipment that I have described in this column over the years, finding a hidden signal ought to be easy, right? Alas, T-hunting is far from an exact science. What's more, the hider is doing everything possible to foil you at every turn. That challenge is what makes it fun!

In a recent exchange of messages on a Usenet ham radio newsgroup, 20 T-hunters told of sneaky spots where hams have put hidden transmitters. A majority involved low-power unattended T's in unlikely places such as the hollow of a tree, the trunk of a police car, a baby carriage at the zoo, and suspended by a wire under a bridge. Christopher Greenhalgh N8WCT wrote, "It's fun sitting in your car, watching the guys run up to you with a big smile thinking they have won, only to say, 'You have to find the actual transmitter,' which you have stuffed in a bush about an eighth mile away, being watched through your side-view mirror."

Canned messages from canned T's

For stunts like these, you need a self-contained T package, ready to deposit at the hidden site and leave for the duration of the hunt. Ten years ago, hams made them with miniature tape recorders. Endless-loop cassettes designed for answering machines would repeat sound effects or short messages continuously, along with station identification.

The possibility that a T will get drenched by rain, heavy dew, or automatic sprinklers makes some sort of sealed enclosure a necessity. Military surplus ammunition cans are a popular choice because they are waterproof and will hold a handie-talkie, recorder, audio/timer board, and sealed lead-acid battery big enough to power the HT for several hours. Sometimes the hunt circumstances demand something even smaller. Two meter transmitter boards by Agrelo Engineering (see last February's "Homing In") are just right for occasions when you need a truly tiny T. That company also sells miniature digital voice recorder (DVR) boards that perform like a cassette recorder, but are stamp-sized and more reliable.

Agrelo Engineering has plenty of experience with digital voice technology. According to owner Ioe Agrelo N2OOC, "Our principal business comes from custom designs involving our DVR boards for clients around the world. They are great annunciators for product displays, vending machines, amusement parks, and museums."

N2OOC recommends his Micro 1.4 models (**Photo A**) for most hidden T applications. "This is a multi-message microprocessor-controlled recorder designed around the ISD2500 series voice recorder chip, using Direct Analog Storage Technology (DAST)," he says. "The voice messages are in EEPROM and need no battery backup for 100 years. This is not a computer voice synthesizer, but an actual digital audio recorder, so the sound is very natural. Its 'sleep' mode increases battery life. When standing by between messages, it shuts down power going to parts that are not being used."

A standard Micro 1.4 board will record and play up to 255 separate messages, totaling up to 90 seconds. It has an external trip terminal for each of the first four messages. A momentary ground on a trip pin causes the unit to wake up, play the entire message, then go back to sleep. While the message is playing, the on-board microcontroller holds a push-to-talk (PTT) output high or low (your choice) to key your hidden T. Holding a message pin grounded causes the unit to repeat (loop) that message continuously.

The loop mode is ideal when T-hunt rules require a continuous transmission. On the other hand, the ability to go to sleep makes the Micro 1.4 ideal for Ts that transmit infrequently. For example, the MMRA hunts in eastern Massachusetts are often difficult long-term events with transmissions only every five minutes or so. To take advantage of the sleep mode, you will need a simple external timer circuit to ground a message trip input when a transmission is scheduled. N2OOC says he plans to sell a circuit board for such a timer; it may be available by the time you read this.

The ISD2500 chip contains an on-board amplifier capable of putting 50 milliwatts of audio into a small speaker. You won't need that much audio to drive the mike input of your transmitter, but it might be useful for building decoy "audio bunnies" to spoof the hunters as they "sniff" on foot.

Two tiny push-buttons on the Micro 1.4 control all functions and programming. They double as Record/Play buttons and Menu/Sub-menu buttons. Once you have recorded your hidden T message using the supplied electret microphone, it will take some button-pushing to get into the Auto-Play mode and set the delay time. First command it into the Menu/Sub-menu mode, go to menu 2, 3, or 4 (for 10-60 seconds, 1-6 minutes, or 10-60 minutes delay, respectively), press Sub-menu the correct number of times for the delay you want (counting the number of LED flashes to be sure you did it right), then press both buttons to start the program. If power to the board is interrupted for any reason, your message is not lost but you must repeat the above sequence to get it into Auto-Play mode again.

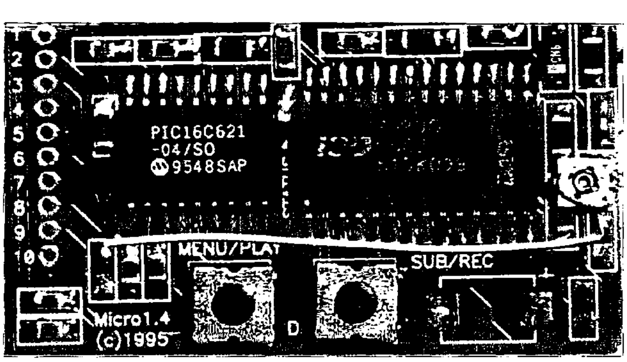


Photo A. The Micro 1.4 Digital Voice Recorder board measures only 1" x 1-7/8". This is the simplex repeater version, which gets all incoming audio from the repeating transceiver. An electret microphone is supplied with all other versions.

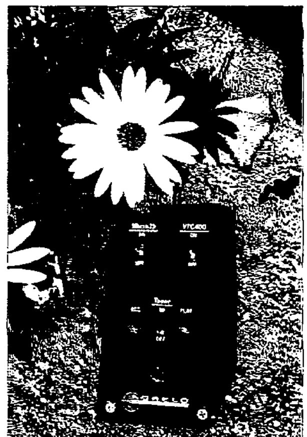


Photo B. This little hidden T has gotten a workout during practice sessions for on-foot foxhunts at Hamcon-95 and the West Coast VHF/UHF Conference. It contains a digital voice recorder, timer board, and 190-milliwatt transmitter, all sold by Agrelo Engineering. Four AAA alkaline batteries power it.

If you are concerned that accidental interruption of power during the hunt will upset the programming or if you want to avoid all the button-pushing during setup, you can have N2OOC make a custom "fox" version of the Micro 1.4 for you. When power is applied, it will come up in the Auto-Play mode. The transmission timing for such a custom unit is predetermined and cannot be changed in the field.

To illustrate how easily Agrelo microtransmitters and DVR boards go together to make a tiny T, N2OOC built one in a 4-3/8" x 2-1/2" x 1-1/4" plastic box (**Photo** B). "The label was made on Corel Draw and laser printed," he says. "Then clear packing tape was applied to the top and cut out. This is a great way to make your own labels."

The enclosure could have been much smaller; size was dictated by the need to have big enough batteries to power the T for the duration of a hunt. Switches should be relocated inside the box to prevent accidental movement. Agrelo Engineering sells two smaller Pactec ABS plastic enclosures (2.4 x 1.6 x 0.8 inches and 2.4 x 2.3 x 1.0 inches), but does not sell complete T's like this.

What's that echo?

Although you call your local .34/.94 machine a "repeater," it doesn't actually repeat what you say. It merely listens to you on one frequency and retransmits your audio in real time on another. On the other hand, your packet controller in the digipeater mode really is a repeater. It digitally "records" packet messages and "plays them back" on the same frequency a few seconds later. If a voice repeater did the same thing as a digipeater does, it would be a true simplex voice repeater.

A simplex voice repeater in a good location allows weak portable and mobile stations to hear one another's transmissions, just like a regular duplex repeater. Its only drawback is that users must wait for each transmission to be recorded and played back. On the other hand, a simplex voice repeater doesn't require a duplexer or multiple antennas because it operates on only one frequency and doesn't transmit while receiving. All that is needed is an ordinary transceiver, antenna, DVR, and some additional logic for control and timing. A complete simplex repeater system can fit in a briefcase, ready to deploy following an emergency.

Joe Agrelo says, "One day a good friend, George Chapek N2AIG, asked if we could turn our DVR into a simplex repeater for emergency preparedness. We did it, and now anyone can get one. Currently our first Simplex Repeater is being used by our local RACES group with great success."

The Agrelo Simplex Repeater board is a custom version of the Micro 1.4 DVR, with a different microcontroller. According to N2OOC, "The PIC16C620 has four analog inputs as comparators and voltage references. The DVR microphone input becomes the audio input from your receiver. The speaker output goes into the mike input of your transmitter. There are two PTT output lines, one high active and one low active.

"The intelligent squelch feature is accomplished by the microprocessor's analog input," Joe continues. "The audio threshold is about 1 volt peak-to-peak. When the processor detects incoming audio, it goes into the record mode. When there isn't any audio for more than four seconds, or if the DVR chip reaches overflow, the unit stops recording and goes into the playback mode."

Agrelo Engineering sells the Simplex Repeater board for the same price as other Micro 1.4 versions. Repeater functions are fixed in the unit's memory, so at power-up it performs a self-test, then goes into the Simplex Repeater mode automatically. The station ID message is in non-volatile memory. Because of the circuit differences, the Simplex Repeater version cannot be reprogrammed into the timed Auto-Play modes of the standard version.

What does all this have to do with T-hunting? Well, think how much fun a concealed simplex repeater would be as a hidden T!

> ***"A complete simplex repeater system can fit in a briefcase, ready to deploy following an emergency."***

Hunters would have to transmit to it in order for it to transmit to them. It would also mimic any other hidden Ts on the frequency. Of course, hunt rules would have to allow for such a device and all transmissions would have to be shorter than the repeater's maximum storage time.

I tested the Agrelo Simplex Repeater in March when WA6OPS, WB6UZZ, KE6IPY, and I hid for the Fullerton Radio Club's monthly Saturday night hunt. Rules require continuous transmissions so we used it as an optional second T, just for fun. When hunters found the main T on 146.565 MHz, a note instructed them to QSY to another simplex frequency and call us. It was then that they learned their transmissions were being delayed and repeated from an unknown location that they would have to find if they wished to have a bite to eat with the rest of the group. The hidden repeater was in our van in the parking lot of a restaurant, hooked to a beam pointed at the main T site a few miles away. Through it, we easily worked the hunters with our handie-talkies from inside the diner.

The Simplex Repeater performed quite well during my tests. Its intelligent audio squelch circuit actuated reliably, losing only a syllable or so at the beginning of some transmissions. Operating through a simplex repeater takes some practice and patience; you must stand by while your QSO partner completes a transmission and it is repeated after a four-second delay. Frequently, operators who could hear each other directly made quick-keyed exchanges without waiting for their replays. When they finished, the simplex repeater dutifully coughed up all their transmissions. But if the exchange went longer than 85 seconds, the simplex repeater keyed up immediately and began playing at the 85-second mark.

The last five seconds of the simplex repeater's memory are reserved for station identification. Five seconds was enough for me to say, "This is the KØOV hidden simplex repeater. Come and find me! But if you want me to transmit to you, you must first transmit to me on this frequency." The Micro 1.4 automatically plays the ID message after every fourth retransmission. If the frequency becomes inactive, it identifies again ten minutes after the last ID, then remains silent until another incoming signal reactivates the repeater function.

The procedure for recording the Simplex Repeater ID message is a bit tedious, but you only have to do it once. The unit must be fully functional with a transceiver attached. You will need another HT or transceiver to talk to the repeater. Press both the Record and Play buttons and wait 85 seconds for the unit to scroll to the end of memory. The LED will be on for the 85-second period, then flash to indicate it's time to record your ID message. Press and hold down the Record button while keying the HT and saying your ID message into the HT microphone, then release the Record button.

Be cautious and you'll succeed

All Agrelo DVR boards are fully assembled and tested, but using one is not a simple matter of "plug and play." Power must be +5 to +6.5 volts DC, so a regulator from your 12-volt source is a necessity. The PTT outputs will source or sink only 20 milliamperes maximum and will switch voltages no higher than the supply. This makes an external relay mandatory for keying most ham transmitters, including handie-talkies. I used an inexpensive reed relay from Radio Shack™, part number 275-232.

I mounted the Micro 1.4 on a 2-1/2" x 1-3/4" piece of unclad perforated board along with the relay and regulator circuits. Cables from this board went to the hidden transceiver's mike, speaker, and PTT connections.

You will need a good eye and a fine-point soldering iron to attach wiring to the row of 10 tiny terminals. Use utmost care in wiring up your Micro 1.4 because its ICs are susceptible to electrostatic discharge damage and the unit is not tolerant of short circuits. The manual cautions never to short the speaker terminals to each other or to ground, never ground the microphone preamp input, never exceed 6.5 VDC supply, and never press a button until all status LEDs are off. Any of these actions can cause permanent damage.

I found that the setting of the transceiver volume control is quite critical for proper Simplex Repeater operation. Not only does it determine the audio quality of the recorded and played back transmissions, it also affects the intelligent audio squelch circuit. If volume level is too high, retransmitted audio will "chop out", and if too low, it will not trigger on stations with low audio. The little LED on the board will barely flicker on audio peaks when the volume adjustment is correct. A little trial and error experimentation is in order here.

You will probably find as I did that the proper audio level setting is quite low. The Micro 1.4 intelligent squelch voltage comparator requires a DC ground reference on the audio input. If your radio's audio output is capacitor-coupled and the DC path is broken when you plug into the external speaker jack, try putting a 10-ohm resistor in parallel with the DVR audio input.

Some transceivers put out low level audio hiss or hum at the speaker jack, even when squelched. This will prevent the audio comparator from working properly. To use such a transceiver with the Simplex Repeater board, you must add a carrier-operated squelch circuit (COS) to the receiver. The Micro 1.4 has an input to accept the COS output.

Micro 1.4 DVRs are available from Agrelo Engineering, 1145 Catalyn Street, Schenectady, NY 12303, (518) 381-1057. Both the standard and Simplex Repeater models cost $69.95 each for ninety seconds total audio storage time. Twenty- and sixty-second versions are available at slightly lower cost. Custom programming is available for additional charges. For quantity pricing, warranty information, and shipping rates, see Agrelo's Web page (URL is http://home.navisoft.com/agrelo/ae.htm) or call the company. Send E-mail inquiries to JAgrelo@aol.com.

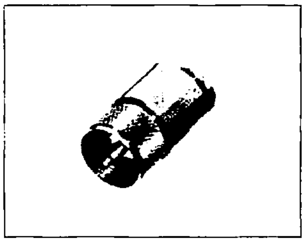
I want to hear about T-hunts you have experienced where DVRs and/or simplex repeaters were used in clever ways. I prefer E-mail for correspondence (send to Homingin@aol.com or 75236.2165@compuserve.com). I also welcome your cards and letters sent to the address at the beginning of this article.

"You won't need 50 milliwatts of audio to drive the mike input of your transmitter, but it might be useful for building decoy 'audio bunnies' to spoof the hunters as they 'sniff' on foot."

New Products

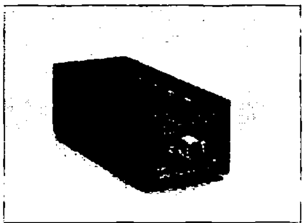
Number 55 on your Feedback card

Waterproof PL-259 Available Now



RF Connectors announces the RFU-503, a UHF male solder clamp connector. This PL-259 waterproof plug features silicone rubber front and rear gaskets. The center contact is silver-plated for optimum solderability, the insulation is Teflon™, and the body is nickel-plated.

The RFU-503 is available from RF Connectors Distributors throughout the US, Canada and Mexico. For additional information, call 1-800-233-1728 or E-mail: 102061.2261@compuserve.com.



Ameco Keeps Its Cool

Ameco announces two new, high-performance broadband RF loads: Model DL 1500 is an air-cooled unit that will handle an average of 1500 watts for up to 15 seconds and 150 watts continuously from DC to 650 MHz.

Model DL 1500-F is a forced-air cooled dummy load. It will handle an average of 1500 watts for a full 30 seconds and 300 watts continuously. The DL 1500-F has a low-noise fan that helps keep the non-inductive load element cool for longer life. The SWR for both models is 1.1:1 for 160 to 2 meters, 1.5:1 to 70 cm.

Both units come in a strong, lightweight aluminum case perforated to enhance cooling. For more information, call, write or FAX Ameco Corporation, 224 East Second Street, Mineola, NY 11501. Phone (516) 741-5030; FAX (516) 741-5031.

Continued on page 64

Simple Inductance Meter

Measure small inductances with this easy-to-construct instrument.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30 - c/o Defendini
Salinas P.R 00751-0030

The ability to measure small inductances in the range below about 15 microhenries (µH) is of the utmost importance when winding toroids for VFOs, coupling transformers in receivers and transmitters. Many junk boxes contain small coils, IF transformers, and other oddments salvaged from old radios and television sets which, if one knew what their values were, might well be put to use in home-brew equipment. There are commercially available LCR meters which look like DMMs, but which cost well over $100, far more than the usual ham budget can cover. Some DMMs costing a bit less than that have an inductance measuring capability, but only in millihenries (mH) and henries, which is of little use to most hams.

What we need is a simple, inexpensive instrument which anyone can easily construct, and which will measure these important small inductances (coils) with reasonable accuracy. The simple instrument described here will enable you to measure coils in the range from below 2 µH to above 15 µH. This range includes all the values of inductance used in VFOs and most, if not all, RF coupling transformers wound on toroids.

Although this circuit is *theoretically* capable of measuring inductance below 1 µH, in the real world the unavoidable stray capacitance and inductance will usually make measurements this low impossible with such a simple circuit.

It is possible, by using a different frequency crystal than that specified, to shift the range over which measurements can be made. A lower frequency crystal, down as far as 1 MHz, will enable measurement of inductances as large as 1 mH, but the smallest value measurable will rarely be smaller than about 75 µH. Crystals between 1 and 10 MHz will allow measurement ranges between that just given and the design range of this instrument using the specified 10 MHz crystal. Use of a higher frequency crystal, up to 13 MHz, will not allow much smaller values to be measured because of the effects of stray capacity and inductance. Crystals above about 13 MHz will not oscillate in this circuit.

The circuit

Fig. 1 shows the schematic diagram of the Simple Inductance Meter. U1, a 74LS00 two-input Quad NAND Gate logic integrated circuit (chip), two resistors, a capacitor and a surplus microprocessor crystal form a stable crystal oscillator near the marked frequency of the crystal. The RF voltage is taken from pin 8 through isolation capacitor C3, to the measuring circuit. RF voltage is applied through capacitor C7 to J1, a binding post. This same RF voltage is applied to a resistive voltage divider consisting of R3 and R4. A germanium diode D1 has its anode connected to the junction between R3 and R4. RF across the variable tuning capacitor C6 is applied back through C5 to the cathode of D1 and load resistor R5, the lower end of which is bypassed to ground through C4 and applied to the positive terminal of meter M1. R6 is a *sensitivity* control connected between the negative terminal of meter M1 to ground.

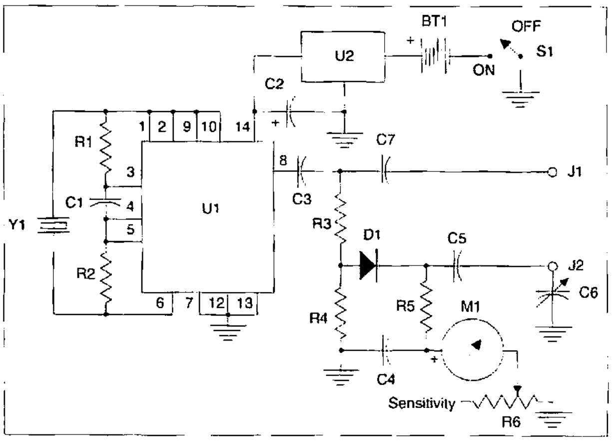


Fig. 1. Schematic diagram.

At first glance you may think this instrument uses a bridge circuit, similar to that used in my Simple Capacity Meter; this is incorrect. This instrument operates by measuring the RF voltage developed across C6, which will be the highest when the series circuit, made up of C6 and the unknown inductance, is at resonance at the crystal frequency. In other words, the value of the unknown inductance is indicated on the dial attached to C6 when the voltage indicated by M1 *peaks*, just the opposite of bridge operation.

Construction

This instrument should be constructed on a small piece of perf board or on one of the general purpose printed circuit boards available at Radio Shack™. It should be mounted in an aluminum box, or in an enclosure made from pieces of printed circuit board material, because of the high frequency at which it operates.

Capacitor C6, and binding posts J1 and J2, should be a few inches apart so that when your fingers are adjusting C6 you don't interfere with the field around the inductance being measured.

Leads between J1 and C7, and between J2 and C5 and C6, should be as short as possible, considering the physical distance between J2 and C6. This latter lead should

be bare solid wire, fairly large (up to AWG-12), and should be spaced away from the enclosure wall. Using a fairly large diameter solid wire, and spacing away from enclosure walls, will reduce the amount of stray capacity and inductance in this critical portion of the circuit. You can use as small a wire as AWG-22, but the larger the wire you use, up to AWG-12, the lower the stray inductance.

in the knob. Scribe or otherwise mark an index line on the panel extending a short distance outward from the edge of the dial.

Calibration

You will need a few small inductances of known values to use in calibrating the dial. Tiny inductances sold as RF chokes are suitable. Most are available with a ±10% tolerance, which will be adequate.

"This inductance meter should be mounted in an aluminum box, or in an enclosure made from pieces of printed circuit board material, because of the high frequency at which it operates."

Meter M1 can be either a standard 0–1 mA meter, or one of the small plastic meters originally made for CB radio or home entertainment equipment. These latter meters usually have 200–300 µA movements, and the value of R6 may have to be increased by adding a resistor in series with it if the more sensitive meters are used.

However, if you have an analog VOM with a current range of 1 mA or less, and a DC voltage range of 2 or 3 volts, you could install a pair of binding posts instead of M1 and use your VOM to read the peak voltage at resonance, saving the cost of a dedicated meter. Depending upon the Q of the unknown inductance being measured, you may need either a low current or low voltage range on the VOM.

You will have to make and calibrate a dial for C6. Most hams save the circular metal or plastic cutouts made when installing meters and small speakers. These make ideal dials when white card stock is glued to one side, trimmed, then centered and cemented or epoxied to the bottom of a knob, with the knob on the white side of the dial.

If you do not have such a circular cutout—you will probably have one if you mount a standard meter for M1—you can scribe a circle on a sheet of heavy, stiff plastic or cardboard, cut it out carefully with scissors or a hobby knife, then cut a hole in the exact center to pass the shaft of C6. If your dial does not have a clean white surface, glue a piece of white paper or index card stock on it. Trim it when the adhesive has dried, and cement or epoxy it to the bottom of the knob for C6.

Mount the completed dial assembly on the shaft of C6 and tighten the set screws

though if you use 5% tolerance chokes, such as those available from Mouser Electronics, your measurements will be more accurate.

If you purchase the following small RF chokes, using them singly and in series in various combinations will allow calibration points at approximately every microhenry from 2 or below to above 15: Buy two 1 µH; two 2.2 µH; one 4.7 µH; and one 10 µH RF chokes to use as calibration standards. Remember, if you connect inductances in series, add the individual values; if you connect them in parallel you can use the formulas for parallel resistors to determine the resulting value. Those values suggested result in only series connections, adding each value to reach the total value, *except* for calibrating at 0.5 µH, where both 1 µH RF chokes are connected in *parallel*. It is extremely unlikely that you will be able to calibrate as low as 1 µH, but you might be lucky!

Switch S1 to ON. Connect a calibration inductor between J1 and J2, adjust C6 for a *peak* indication on M1, and mark this point on the dial. Number it with the value of the calibration inductance. Continue calibrating the dial with various combinations of inductances in the same manner.

You will not be able to number each calibration point, especially if you calibrate at approximately every microhenry. The dial will be very crowded at the high inductance end, but much less so at the low end.

Operation

Switch S1 to ON. There should be some indication on M1, which shows that the instrument is functioning. Connect an unknown inductance between J1 and J2, adjust C6 for a *peak* indication on M1, using the *sensitivity* control as needed, and read the value of the unknown inductance from the dial of C6 opposite the index mark on the panel. If you are using an external analog VOM instead of M1, you may have to switch between DC current and DC voltage ranges to keep the needle on the meter scale, or you may use the *sensitivity* control.

The higher the Q (quality factor) of the unknown inductance, the higher the peak indication on M1 and the VOM. Conversely, a low Q inductance will register a lower peak indication. This simple circuit will not measure Q directly but will allow relative indications. Inductors used in frequency-determining portions of VFOs should have the highest Q possible. This means using the largest diameter wire commensurate with the space available on 70% of the toroid core used. If an air core coil is used, its diameter *and* length should be as close to the same dimension as possible, and be wound with the largest diameter wire practical. This will result in the highest Q coil possible.

Parts List

BT1	9V alkaline battery
C1,C3,C4	0.01 µF ceramic disc capacitor
C2	10 µF 16V electrolytic capacitor
C5	0.001 µF ceramic disc capacitor
C6	365 pF variable capacitor
C7	560 pF NPO, COG, Mylar™ or poly capacitor
D1	Germanium diode: 1N34, 1N60, 1N90, 1N270, etc.
J1,J2	Binding post
M1	0-1 mA DC meter (see text)
R1,R2	560 ohm 5% 1/4W resistor
R3,R4	100 ohm 5% 1/4W resistor
R5	1k ohm 5% 1/4W resistor
R6	10k ohm linear potentiometer
S1	SPST toggle or slide switch
U1	74LS00 two-input quad NAND gate

Number 58 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

In last month's column. Robert Blacka N2WSO offered a good tip on a line of "camouflage" rope offered by The Lehigh Group of Allentown, PA. Since then, I've received their well-laid-out catalog of cordage and accessories, and the rope that Bob mentioned seems to be Lehigh's item # CF450 (the number mentioned in the column last month may be the dealer's stock number along with a UPC code). The catalog describes it as twisted polypropylene rope and says that it holds knots well; resists oil, gasoline and most chemicals; is resistant to rot and mildew: and floats (a trait hopefully not needed in ham radio applications). The standard length is 1/4" by 50'. It comes with an instruction booklet that outlines its proper use and care and describes knotting and splicing methods. Lehigh's phone number is 1-610-398-1830. Their catalog is worth having for general information on cordage and fittings.

Pinpoint it with a laser

We've all heard the expression "a solution looking for a problem." That's what I had considered those new "pocket laser pointers" to be until I thought about it some more. The pen-sized pocket laser pointers are advertised as being useful for large group presentations, and they no doubt are, but how many of us give large group presentations often enough to justify the purchase of one? No question, they'd be fun to play with (just don't look at it or its mirrored-reflection directly), but I needed a bit more incentive than that to spend the money for one. Well, for those of you in the same predicament, here's the justification you've been looking for, and it's a useful one.

It's usually easy to locate the correct component for replacement on the component side of a printed circuit board since the part numbers are generally silk-screened on that side, but locating the proper pads to unsolder on the foil side of the board is another matter altogether. That's where the little hand-held laser pointer comes in.

Simply hold the pointer over the correct component, on the component side of the board, and then, looking at the foil side—perhaps with the room lights dimmed a bit—you'll be able to see the exact point to unsolder. It's particularly useful with phenolic PC boards, but it even works on the heavier Fiberglas™ boards (though the light does scatter a bit more, depending on the density and "grain" of the board material).

If you'd like to drill a hole through a plastic case, but you'd also like to see where it will end up on the other side of the case before you drill, the laser light will even penetrate some of the less-dense plastics. Too bad it doesn't penetrate aluminum...or drill the hole for you...at least not yet!

Finally, our two younger cats love to chase the "red dot." Be careful not to shine the pointer directly into your own or your cat's eyes; again, intense laser light can be dangerous if misused. Lasers derive their pinpoint energy by forcing all of the photons to march in step, at exactly the same color frequency and in exactly the same direction, much like a well-drilled military marching unit. By the way, our older cat shows some (though dignified) interest, but apparently he considers the laser pen just another variation on the old "dancing-flashlight-beam game!"

These are my contributions. What problems have you solved using this latest "solution looking for a problem" device? Send me your ideas, at the address in the masthead, and I'll compile them for a future column on "sharp-laser-pointer tips."

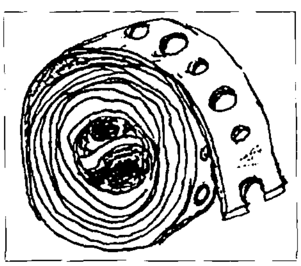


Fig. 1. Steel plumbing strap, as it comes from the blister packaging.

A strapping good idea

From James E. Brown AE4EY: This suggestion is certainly worthy of consideration. He writes: "My shack is located in the basement of my home, and the closest nearby ground is the cold water pipe running through the rafters about five feet above my operating position. In the past, I simply used wires from each piece of equipment, joined together at one connection point, then a single wire running up the wall and to the cold water pipe. The final attachment was done with a worm-geared hose clamp. There were times when I was plagued by RF feedback due to the many wires acting as resonant antennas at various operating frequencies; I also had concerns about the necessary low-resistance of a single wire grounding system.

"I spotted some steel plumbing strap in the hardware store one day, and pictured that as a much better solution to my RF grounding woes, which indeed worked out that way. The steel plumbing strap is inexpensive enough, between $1 to $2 for a 10-foot blister-packed roll. A couple of rolls of the strapping, plus a dozen 6-32 machine screws, nuts, and washers are all that you need to get going. The particular strapping I'm using is 3/4 of an inch wide and 10 feet long, containing alternating 1/4-inch and 9/64-inch holes throughout its entire length. It's made for jobs like hanging plumbing pipes from wooden rafters, and is easily cut with tin shears or a hacksaw to provide you with the exact length needed.

"**Fig. 1** shows the strapping as it comes from its blister-pack. It's easily bent around a circular fastening point or shaped any other way that might be needed to achieve the desired end. **Fig. 2** shows the connection point to the cold water pipe in my own installation and **Fig. 3** illustrates how a solid splice is made to extend the strapping length. **Fig. 4** shows how I've chosen to tap onto the main strap at each piece of equipment, and **Fig. 5** depicts how that piece of gear can be securely fastened to the tap-off using the existing grounding stud present on most amateur gear.

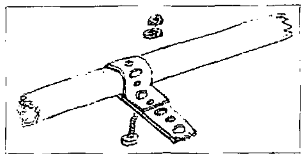


Fig. 2. The connection to an overhead cold water pipe run.

"Since installing the strap grounding system, I've experienced no further in-shack RF feedback problems. What's more, the jumble of grounding wires has disappeared and I've no further doubts about the adequacy of my shack ground system. Be sure that you ground every piece of gear, including any coaxial switches, antenna tuner and the chassis of your shack computer. The more thorough you are in this area, the fewer problems you'll experience with stray RF and/or digital noise ending up where it shouldn't be."

Jim's idea is a good one to keep in mind for your next shack rebuilding project. Since it's relatively inexpensive steel strapping, there will be some inherent RF resistance present in it, but its sheer bulk helps to minimize that factor. If you can find copper hanger strapping, so much the better, but be careful not to mix dissimilar metals if you can possibly avoid it (because of the possibility of electrolytic action taking place at the junction). Also, be sure to carefully sandpaper or wire brush all connecting points for the lowest resistance connections. Both steel and copper quickly oxidize to form high resistance surfaces. If you're using a cold water pipe as the final ground reference, make sure that

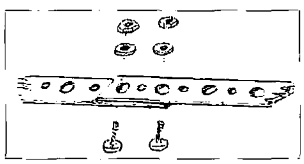


Fig. 3. Splicing two sections of strapping to extend the length.

connection is also well cleaned, and that there are no non-conductive pipes in the line all the way to where it enters the earth ground. Any water meters or other in-line devices should be bypassed with a heavy wire shunt since their carry-through conductivity may be questionable. In a basement installation, quite often a hole drilled through the concrete floor, with a 6- or 8-foot ground rod passing through it, will end up being the shortest and best path to earth ground. Be careful not to inadvertently hit any under-floor pipes or tiles!

A line of affordable project boxes

If you're anything like me, you can never have enough sources for small project boxes, perhaps for a microphone adapter, a couple of outboard switches, or maybe a small-circuit idea consisting of just three or four parts.

One such source of small boxes that I recently came across is Sescom, Inc. of Henderson, Nevada. Their mainstream business is in serving the independent television production community with cables, adapters, amplifier modules, etc., but their newest catalog also boasts a number of what they call "Mini Project Boxes" that are perfect for many ham radio construction needs. Their MPB-1 at $1.95, for instance, is only 1" x 2" x 1", and has proven to be very useful in my own ham shack for small projects. Their current full line consists of a total of 24 various-sized project boxes, from the MPB-1 mentioned to the MPB-2, measuring 1" x 4' x 1", an the MPB-3 at 1" x 6" x 1", on up to the MPB-24 at 4" x 14" x 3" at $6.10.

The boxes are an exclusive design and consist of four flat aluminum sides, two flat aluminum end pieces, four channeled-aluminum 90° "micro extruded" corner angles, and eight self-tapping steel end screws. The flat aluminum sections are .04 inch thick and are unpainted; they're easily drilled or punched medium-hardness aluminum stock, with plastic protective film on both sides for scratch protection during shipping and handling. They arrive unassembled, an interesting concept in mini-box shipping and storage that makes drilling or punching much easier since you're always working on a flat piece of stock.

Assembly takes only a few minutes, and consists of slipping the flat aluminum side plates into the channeled corner angles, then attaching the two flat end plates with the eight small self-tapping screws. The box can be primed and painted if desired—either assembled or unassembled—to match whatever piece of existing equipment the user might want to complement; or it can simply be left natural and perhaps given a brushed finish with a piece of soft steel wool.

Another interesting side benefit of the assemble-the-box-yourself design is the nearly unlimited customization of the final size. If you need a box that fits exactly into a given space, one of the Sescom "Mini-Project Boxes" may be just the answer. Simply choose the box closest in size—but slightly larger—than what you would ideally want, then cut the stock down to the exact size needed with a bandsaw, and you'll have the perfect box to fit your available space. This is something that's virtually impossible to do with pre-formed or molded project boxes.

Sescom's phone number is 1-800-634-3457, or write to 2100 Ward Drive, Henderson, NV 89015-4249, and request their latest catalog. Also unique is their free UPS ground shipping on all orders over $20—plus a 10% discount on quantities of 10 or more of the same size box. Not a bad deal.

By the way, any commercial products that I mention in this column are completely unsolicited; they're either items that I've actually tried, or ones that have been recommended by *73* readers. I've not been approached by any manufacturer and wouldn't respond if I were. The intent of this column is to inform *73* readers of ideas, tips, suggestions, and, yes, sometimes unsolicited products if they apply. It's not a paid ad sheet. I just want to make sure this is clear.

A handy paddle reversing switch

From Gary Bartlett VE1RGB: An idea that fits well into the Sescom MPB-1 project box talked about above. "As an ardent CW Op, I frequently carry my own paddles with me when operating someone else's station—such as on Field Day. Not every rig, however, is polarized the same way with regard to which input connection is 'dit' and which is 'dah.' Trying to rewire the paddles each time, in the dark or the cold, isn't really the answer. The real answer is a small, sturdy project box, containing an easily operated DPDT paddle polarity reversing switch...one that will work from one set of paddles to another, as well as from one transceiver to another. Fitted into a small aluminum box, the reversing switch (**Fig. 6**) will also allow you to change 'keying hands' quickly, such as when the need to log with your right hand forces you to send with your left. Few Ops can master that feat, but the reversing switch makes it possible."

"Quick testing" capacitors with an ohmmeter

From Peter Albright AA2AD: Some good information for us on the theory and practice of testing capacitors with the absolute minimum of test equipment. "Did you know that your analog (needle-style) multimeter can be used in the 'ohms' position to test capacitors? Although the theory is straightforward, practice is a bit tricky because of differences between real-life multimeters. Follow along and you'll see why."

THE THEORY: In a DC circuit, capacitors act like a reservoir, holding electrons rather than water. When a DC voltage is applied to a capacitor, it fills (charges) as electrons pile up on the plates. While it's charging, there is measurable current flow in the leads. Current flow, or amperage, is greatest when the capacitor just begins to charge; at the instant that voltage is first applied the capacitor looks pretty much like a short circuit, with a resistance value of near zero ohms. Current flow approaches zero as the capacitor approaches a fully charged state. When fully charged, the capacitor looks like an open circuit, with nearly infinitely high resistance. A perfect capacitor would hold this charge

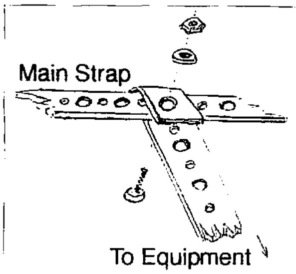


Fig. 4. Tapping into the main grounding strap for connection to an individual piece of equipment.

forever, or until the electrons are drained off by some external circuit connecting the capacitor's two plates. Even a real-life capacitor can hold its charge for quite some time.

An ohmmeter works by applying voltage across the device to be measured. Although the meter is calibrated in ohms, it is actually measuring current flow. Remember Ohm's Law:

$I = E/R$

For a given voltage, the lower the resistance, the higher the current. An interesting, counter-intuitive corollary is that analog ohmmeters put a resistor network between the meter and the device to be tested. When you switch the meter to a higher resistance measurement range, the resistance value of that network is increased.

There's one final piece to the puzzle. When a capacitor is charged through a resistor, an elementary timing circuit is created. Increasing either the value of the resistance in ohms (limiting current flow) or the value of the capacitor in farads (the size of the

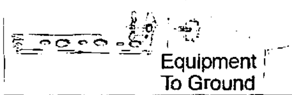


Fig. 5. Connection to the actual piece of ham gear at its rear ground stud. If a direct connection via the steel strapping isn't practical (because of the need to pull a particular piece of equipment out to gain access to the rear apron), then a short piece of flexible braid with a terminal lug installed on it (such as the braid from the inside of an RG-8 coax cable) can be used as a jumper to the main strap.

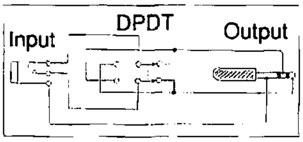


Fig. 6. VE1RGB's CW paddle reversing switch used to flip-flop the "dit" and "dah" connections on oppositely wired amateur transceivers, or for changing "fists" under contest conditions.

"reservoir") will increase the amount of time that it takes for the capacitor to charge fully, and for that charging current, measured in amps, to drop to zero.

THE PRACTICE: As always, begin with a careful visual inspection. Defective capacitors are often physically deformed by bulging, leaking, or showing heat damage. They may be "microphonic," showing functional instability when tapped gently with a plastic stick while the circuit is active. A microphonic capacitor is bad, and no further testing is indicated. After you have decided that there might be a defective capacitor in the circuit, follow these steps:

1. Turn the rig off and unplug it, or remove the battery if that's the source of power.

2. This step is important—it protects you, your equipment, your tools and even the component to be tested. Make sure that the capacitor is fully discharged by placing a direct short between its two leads or terminals with a clip lead. Remember to be careful: If the capacitor is a large value power supply electrolytic cap, it can deliver enough current to put a nice nick in your screwdriver blade, even at 12 volts! It's always a good idea to discharge large capacitors (or capacitors in high-voltage circuits) through a 100 ohm, 2 watt resistor for a full minute or more before putting a dead short across its leads.

3. The capacitor to be tested must normally be removed from the circuit. It's sufficient to disconnect only one lead, leaving the other lead soldered in place since it's only a two-terminal device. After you disconnect the capacitor, discharge it again to be sure its "reservoir" is completely "empty." Even with a dead short across it, a capacitor may take several seconds to discharge completely, because of its inherent internal resistance. Good technicians always practice accepted safety techniques!

4. Now set your analog multimeter to measure resistance. The range setting that you'll choose will depend somewhat on both the value of the capacitor to be tested and the characteristics of your particular meter. On my favorite meter, I generally use the R times 1 range for electrolytic capacitors larger than 50 µF, and the higher scales for those smaller capacitors—up to the maximum of the meter's range for very small ones of .001 µF or less. Remember the theory above? By changing the meter's range setting, you're putting different resistances in series with the capacitor, thus making the time constant of this series charging circuit long enough so you'll be able to see the meter move as the capacitor takes on a charge.

5. Next, connect one ohmmeter lead to one of the capacitor's leads. For electrolytic capacitors, be sure to observe polarity of the capacitor as marked on the case. You can't assume that the negative lead of your ohmmeter applies negative voltage to the outside world, so check your ohmmeter's polarity with a second voltmeter.

6. Watch your meter's needle and touch the free meter probe to the other capacitor lead. The needle should quickly swing toward zero ohms, then reverse direction, and then more slowly work its way back toward infinity. The speed at which this happens depends on the value of the capacitor and the characteristics and range setting of the multimeter. If all of this happens too fast to see, return to Step 3 (discharge the capacitor) and try a higher range setting on your multimeter. If, on the other hand, the meter's needle moves excruciatingly slowly, you can simply switch the meter to a lower range setting without harming anything.

7. If the meter never swings toward zero ohms, the capacitor is open, and defective. If the meter never returns to infinite resistance, the capacitor is "leaky."

8. When the meter reaches infinite resistance, remove one lead. Wait about 20 seconds, then reconnect the lead. The meter may twitch a bit, but if it noticeably swings back toward a low resistance reading, the capacitor is leaky. A good capacitor holds a reasonable charge for longer than 20 seconds.

"You can practice this technique on a variety of capacitor values to get a feel for what should happen with the different sizes, and to determine which range on your own multimeter gives you the most satisfactory reading times. You should get no false negatives: If the capacitor is leaky or open, it's bad. A good reading is not absolutely conclusive, however, because the capacitor may break down under the higher voltage of the actual circuit it's being used in, or it may have changed in value. This 'quick test' tells you nothing about the capacitor's voltage breakdown point, nor does it give more than a rough idea of the actual value—other than by the time it takes to charge through a certain series resistance.

"Also, keep in mind that when replacing a capacitor in any tuned circuit, it is important to use an exact replacement, both in terms of value and type (the material that the capacitor is made of can be critical). The higher the frequency at which the circuit operates, the more critical that replacement exactness becomes. The replacement capacitor's lead lengths should also match the original and its physical placement should replicate the original as closely as possible.

"In the case of power supplies you have some more leeway. Except for the voltage rating, which should be the same or slightly higher, the capacitor's value can generally be up to 150% higher than the original.

"Finally, never use a capacitor with a lower voltage rating than the original, and always strictly observe the polarity markings on electrolytics and tantalums. If you ignore this caution, you'll eventually have a capacitor explode inside your rig like a small firecracker, leaving you with an unpleasant cleanup job."

Hot tips!

From Michael Fratus: A tip on how to spot broken solder connections in ham radio equipment. "Solder breaks make up a higher percentage of direct and indirect causes of failure in electronic equipment than many people think. When working on any ailing printed circuit board, if you notice a semicircular ring around a solder joint—or any sign whatsoever of crystallization or fatigue—touch up the connection with an appropriately hot soldering iron and a bit of fresh 60-40 solder. Pay special attention to the connections on heavier components, any PC board connectors, and all board-mounted controls for signs of 'flex' stressing. This can be a problem, particularly in a mobile environment where lots of vibration is present, and in areas of extreme temperatures.

"Any 'stress fractured' solder joint can become thermally unstable, resulting in an intermittent connection with hot and cold, and is often responsible for what might seem bizarre symptoms. Unless you solve the real problem, you'll be working on that piece again! Taking the time to quality-check the unit while you have the board exposed will give you more time for operating and less for servicing in the future!"

Did someone say "Underground"?

From Bill Thim N1QVQ: An idea for running "coax underground back to your shack using PVC piping as a raceway. It helps protect the coax and also makes running any other cables in the future an easy job. You can buy PVC pipe with holes already drilled into one plane of it, in 4"

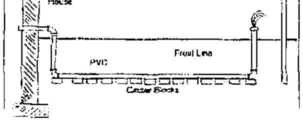


Fig. 7. Side view of the overall PVC pipe/cable raceway scheme described in the text.

and greater diameters. Four inches may sound like a lot, but it can fill up fast if your station antenna farm begins to grow...whose doesn't? The bigger you can manage, the better. Of course, you can also drill holes along a length of smaller PVC pipe if your future plans are more modest. The proper way to lay the pipe underground is shown in **Fig. 7** and **Fig. 8**. Dig a moderately sized trench, preferably below the frost line. When the pipe is laid, the holes should be straight down, the pipe should rest on blocks or loose gravel for drainage (cinder blocks with the hollow channels pointing up and down are an excellent choice). The entire length of pipe should then be 'draped' with plastic sheeting over the top, to act as a water-diverting shield when the soil is placed back over the top of the trench. Sounds like a good bit of work—and I suppose it is—but doing it correctly will save you countless problems in the future.

"A way to handle the out-of-doors end of the run is to construct a 'weather elbow' out of PVC fittings as shown in **Fig. 9**. This type of scheme will not allow water to enter the pipe's end, yet will provide easy access for new cable runs in the future, though more 90° turns are involved. A wad of Fiberglas™ insulation pushed into the end of the pipe will discourage insects and other unwelcome visitors!

"Ideally, the shack end of the pipe should go through the wall of the building itself, for maximum convenience and weather-resistance. You might even put a small 'hamfest-gem' 3- or 4-inch whisper fan at the building end, pulling air from the pipe into your shack, for free cooling in the summer and warming in the winter! The fan will also help to replace the air inside the pipe and keep it dry.

"Finally, an electrician's 'fish tape' should be used for the initial cable pull...don't forget to put in some sort of 'come-along' rope that can be used for future pulls. It can be a loose rope running along side of the cables, or a 'trolley' arrangement, configured with a loop of rope, separately hung, running the entire length of the piping. Sometimes, a loose come-along rope, though simple to install, will wind around the cabling, making it more frustrating to pull in future runs. Consider using the trolley idea if you can; **Fig. 10** shows one way that this can be accomplished on a fairly straight run. Its practicality depends, to some degree, on the length of the run and on the size (diameter) of the pipe. Choose whichever method you feel is most practical for your own installation."

It's obvious that Bill has thought out the problem well, and his suggestions might apply to all of us, no matter what antenna system we might have in mind. As Bill pointed out, it's vitally important to keep an underground conduit raceway dry. Coax cable was never meant to "tread water." Make sure that the cable you choose for an underground setting is free of any (even slight) defects in the outer jacketing. Any moisture whatsoever inside the shielding of the cable will literally destroy the RF shielding quality and conductivity of the cable's shield conductor. The braided shield must make good electrical contact with its neighboring wires to represent a continuous "pipe." We can get away with the flexibility of a braided shield in our cables—as opposed to a solid outer piping—only because each strand of the shield overlays every other strand, simulating a continuously-walled pipe; but that simulation must be maintained throughout the length of the run. Be sure to tune in next month for more worthwhile tips, ideas and suggestions.

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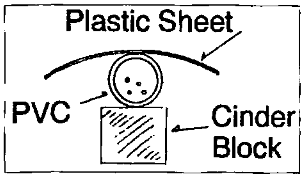

Fig. 8. Cross-section view of the underground PVC pipe/cable raceway described in the text.

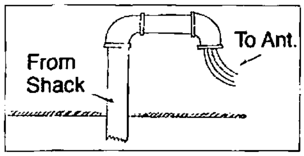

Fig. 9. Scheme for exiting cables at the outdoor end of the run. Though more bends are involved, the possibility of water entering the piping is greatly reduced.

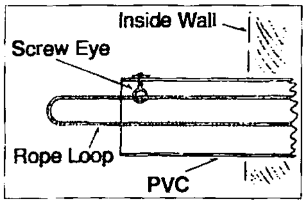

Fig. 10. Side view of PVC pipe/cable raceway as it enters the building interior, showing the cable-pulling rope loop idea in the text.

HAMSATS

Number 62 on your Feedback card

Amateur Radio Via Satellites

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A field of their own

Field Day is once again just around the corner—June 22nd and 23rd. Every year the American Radio Relay League sponsors the event as an exercise in emergency preparedness. Amateur radio groups in the United States and Canada take their ham gear, generators, batteries, and antennas outdoors for the competition. The object is to work as many stations as possible on the amateur bands from 1800 UTC Saturday for 24 or 27 hours (depending on when station setup began).

By the ARRL rules, completing one satellite contact during Field Day earns a 100-point bonus. Contacts via satellite beyond that are lumped together as one "band" and get the same points as other Field Day contacts. Twenty years ago these rules were adequate for the satellites of that time, but today, with a dozen hamsats in orbit, the situation has changed. In an effort to inspire more groups to set up and operate serious satellite stations during the weekend, AMSAT, the Radio Amateur Satellite Corporation, sponsors its own version of Field Day. The dates and times are the same, but there the similarity fades.

The AMSAT competition is to encourage the use of all amateur satellites, both analog and digital. The AMSAT competition is open to all satellite enthusiasts, both domestic and foreign. American and Canadian stations should exchange ARRL section and transmitter-class information. Foreign stations should exchange signal reports and country names. This year CW contacts and digital contacts are worth three points each as outlined below.

1996 AMSAT FIELD DAY COMPETITION RULES:

Analog Transponders

- Each satellite transponder is considered a separate band. This means that AMSAT-OSCAR-13 Mode "S" is separate from A-O-13 Mode "B."
- All phone QSOs and all CW QSOs on a given satellite transponder are considered separate bands. This means that A-O-13 Mode "S" CW is separate from A-O-13 Mode "S" phone.
- Therefore, for reporting purposes, A-O-13 has four possible "bands" including Mode "B" CW, Mode "B" phone, mode "S" CW, and Mode "S" phone.
- All packet/RTTY/ASCII/AMTOR QSOs through analog transponders are counted as CW QSOs.
- Phone QSOs count for one point and CW QSOs count for three points.
- Cross-mode (CW–phone) contacts are not allowed.
- The use of more than one transmitter at the same time on a single satellite transponder is prohibited. This means that two stations at the same Field Day site can operate through A-O-13 at the same time, but only if one is operating Mode "S" and the other Mode "B". If two stations at a given site are set up for Mode "B" operation, only one can be on A-O-13 (CW or phone). The other station can be used for different hamsats (like A-O-10) or other Field Day activities.

Digital Transponders

- For the pacsats (L-O-19, K-O-23, etc.), each satellite is considered a separate band.
- Do not post "CQ" messages. Simply upload ONE greeting message to each satellite and download as many greeting messages as possible from each satellite. The "subject" of the uploaded file should be posted as "Field Day Greetings" addressed to "ALL." The purpose of this portion of the competition is to demonstrate digital satellite communications to other Field Day participants and observers.
- The following uploads/downloads each count as a three point digital contact:

(a) Upload of a Satellite Field Day Greetings file (one per satellite).

(b) Download of Satellite Field Day Greetings files posted by other stations. Other non-Field Day files are not to be counted for the event.

- Satellite digipeat QSOs do not count for any score and the use of gateway stations to uplink/downlink is not allowed.
- The *Mir* PBBS is not to be used for Field Day operations.
- If F-O-20 is active, the JA transponder can be used for analog CW and phone activities under the analog transponder rules, and the JD system can be used as a separate transponder under the digital rules.

Sample Satellite Field Day Greetings File

"Greetings from N5EM Field Day Satellite station near Galveston, Texas, with 24 participating members in the AMSAT-Houston group. All the best and 73!"

Note that the message stated the call and name of the group, where they were located and how many were in attendance.

Operating class and reports

Stations operating portable and using emergency power (as per ARRL Field Day rules) are in a separate operating class from those at home connected to commercial power.

A Satellite Summary Sheet should be used for submittal of the AMSAT Field Day competition results. A copy of this form will be in the AMSAT Journal or can be obtained from me at the address above for a self-addressed-stamped envelope. Deadline for submissions is August 1, 1996.

Competition was tough in 1995 and should be even tougher in 1996. The station submitting the highest score for portable operation using emergency power will receive a plaque at the AMSAT General Meeting and Space Symposium in Tucson, Arizona, November 8-10. AMSAT hopes this event provides satellite operators with the practice necessary to set up a ground station and effectively operate via the satellites in an emergency situation. Remember that Field Day also provides a good opportunity to expose newcomers to the amateur radio satellites. Most of all, it should be a great time! 73

QRP

Number 63 on your Feedback card

Low Power Operation

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More on K1BQT's 15m rig

Last month, we got the transmitter up and running on the 15 meter CW transceiver described by Rick Littlefield K1BQT (*Ham Radio*, January 1989). This month, we'll take a look at the receiving half of the transceiver.

The receiver

Since the receiver is a bit more complex than the transmitter, I've added a block diagram (**Fig. 1**) to guide you though the signal flow. As I mentioned before, I can't reproduce the circuit here.

Basically, the input to the mixer is simple and to the point. A NE602 mixes the incoming signals with the VFO's output. As we saw in last month's column, the front-end mixer also produces the required VFO energy.

Unlike some of the more recent club rigs, like those of the NorCal and NW QRP clubs, the 15 meter rig has four crystal filters. In fact, by matching the crystals, a very tight IF filter is possible. However, I like my CW a bit on the wide side, so no attempt was made to fine-tune this filter. In fact, common computer clock oscillator crystals are used. Digi-Key and Mouser Electronics carry a wide selection. Surplus electronics houses have computer clock crystals in stock as well. Most of the crystals may be had for less than a buck apiece. Pick up a handful; you'll need more than four if you plan on matching them.

After the incoming signal has been mixed and passed through the IF filter, the signal is then applied to an MC1350 IF amplifier. My dealings with this guy have been less than happy!

The MC1350 will easily go into oscillation at the drop of a hat. A common fault most builders have when working with this chip is using an IC socket. The extra lead length combined with the high gain of the amplifier produce all kinds of unusual critters. If you have trouble with an MC1350 and have it installed in an IC socket, remove the socket and solder the 1350 directly to the PC board.

"Most of the crystals may be had for less than a buck apiece. Pick up a handful."

When laying out a PC board, make all the copper traces to and from the 1350 as large as possible. This will keep unwanted inductance out of the circuit. Use a top ground plane if possible; again, keeping inductance down to a minimum.

On this rig, the output of the 1350 is applied directly into an NE602. Here the IF frequency is mixed with the BFO crystal. In my block diagram (**Fig. 1**), I did not show the trimmer capacitor used to net the BFO crystal. Nor did I show the capacitor used to couple the output of the 1350 into the NE602.

Audio

Rick uses a standard audio filter comprised of two op amps. A single 1458 amplifier is used. Rick allows you to select or bypass the filter by a double-throw double-pole switch.

From the audio filter, or directly from the BFO mixer, the audio is fed into an LM386. This 500 mW audio amplifier has become the standard in most QRP rigs. However, in Rick's design, the gain is set high and the volume to the speaker is through an "L" pad arrangement. This is very similar to the design Rick used in the MFJ rigs he designed.

A simple audio-derived AGC controls the gain of the receiver by constantly adjusting the gain of the IF amplifier.

Making the rig work

As with so many projects in various magazines, there are some mistakes in the instructions. Perhaps the most lethal is the lack of interconnections between the relay used for T/R switching and the rest of the circuits.

In the original article there is no mention of how or why the wires should run from the relay contacts to the other parts of the circuits. This one caught even me by the short hairs. Only after spending several hours wondering why the PA was drawing an amp of current without output did it occur to me to trace the output back to the relay. The fix is simple: Use hook-up wire to complete the wiring.

My buddy used computer clock crystals for the IF filter. That's exactly what I said to do. However, in his case the crystals he used were for oscillators used in wristwatches! They just plain did not work in the circuit. The fix? Replace all the crystals used in the filter.

Super-small QRP rigs are a trademark of Rick Littlefield, but most builders don't have access to the vast array of micro parts Rick does. So, to fit some of the silver mica capacitors on the PC board, they must be installed on the foil side. This means that the PC board has to be installed a bit higher off of the metal cabinet, which also means that the leads on the PA transistor have to be a bit longer than necessary.

Another sticky point is that the AGC components are not on the PC board. They are located "sky-wiring style" on the front panel. Without the AGC parts, the gain control to the 1350 is left to dangle. That makes for a rather interesting way to control the gain of a pesky amplifier like the 1350. I got around the problem by supplying the 1350 with enough gain to test out and align the stages. The AGC components will be installed when the circuit board goes into its case.

Building your own version

You might be able to get a PC board for the rig. The original article stated that PC boards were available from RadioKit; I don't know if RadioKit is still around. You might try Far Circuits (18N 640 Field Court, Dundee, IL 60118). Perhaps they have the boards, or the artwork to produce them.

That's all for the QRP 15 meter rig. All we need now is a zillion or so sunspots so we talk to someone else on 15 meters!

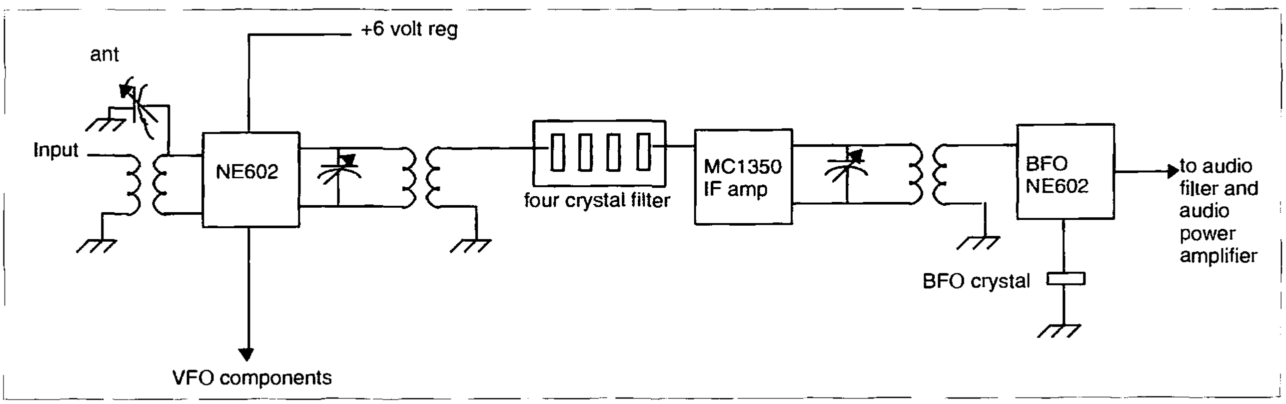
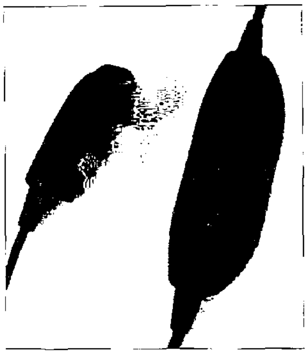


Fig. 1. Block diagram of the 15 meter CW transceiver.

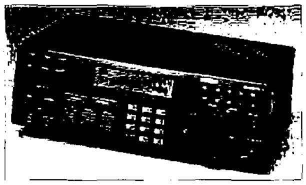
Continued from page 55

MORE NEW PRODUCTS

An Ear Microphone?



Genesys Products Group's Eartalk Mark II combines an earphone and a microphone in their ear unit, picking up your voice via your inner ear. It has a separate PTT switch (with a lock). It's designed for nearly hands-free use with mobile rigs and HTs—no more mike boom out in front of your face. There are models for Icom, Kenwood, and Motorola. The price? $84.95. Geyesys, 10815 Gulfdale, San Antonio TX 78216. Phone (800) 847-4745 or FAX (210) 349-4300. E-mail: genesys@connecti.com.



Proud Addition to MCM's Catalog

Scanning Radios from Uniden America, known worldwide as the leading manufacturer of handheld, mobile, and tabletop scanners, are now being distributed by MCM Electronics.

MCM's semiannual catalogs are also widely known, and MCM's distribution centers enable ground-rate shipping to most of the U.S. within 48 hours. 99% of all orders are shipped within 24 hours. For more information and a free catalog, call 1-800-543-4330.

New Lattice Programmable Logic Development Kit for PC

APS announces the release of its APS-L1016 programmable logic development kit. The system consists of the Lattice pDS(r) Design Software and a test board with a Lattice ispl016 in-circuit programmable logic chip and an ispGDS22 programmable switch matrix. The kit allows for the partitioning, place and route, simulation and hardware implementation, all from the PC keyboard, without burning PROMS or changing parts. The kit sells for $250 and is ideal for evaluation and testing of programmable logic.

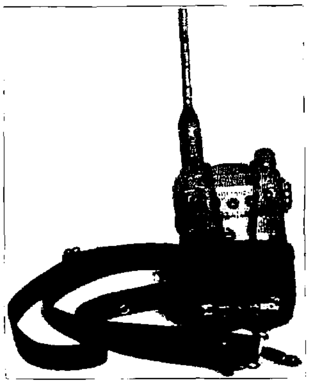
Contact APS (Associated Professional Systems) by phone (410) 515-3883 or FAX (410) 661-2760, or write to: 3003 Latrobe Court, Abingdon, MD 21009.

Vehicle Security Systems

A L Brown, Newnes Publishing, 1996, 86pp., $29. The subtitle is: "Build Your Own Alarm & Protection Systems." If you enjoy building small projects, you're going to love this book. It even has the board layouts for you. It covers car and garage and home alarms, delay circuits, ultrasonic, infra-red, and so on.

The security business is still an easy and profitable business to start in your spare time, and experience that independent feeling that having your own business brings. You may win big or you may fail, but no one can downsize you to the unemployment office, or move your job to Mexico...Wayne

Strap That Baby On!



The new "CLC503" padded Cordura nylon carrying case from Standard is made for both the C508A and the C108A mini-handhelds by Standard. It has nylon cord retainers to secure the radio in place, and a loose-weave nylon adjustable shoulder strap, to keep it comfortable slung over a shoulder or around the neck. The CLC503 attaches to a belt, or even stands up on a desk.

Suggested list price is $19.95. See your amateur equipment dealer or contact Standard Amateur Radio Products, Inc. at P.O. Box 48480, Niles, IL 60714. Phone (312) 763-1181; FAX (312) 763-3377; or reach them on the Web at HTTP://WWW.STDRADIO.COM.

New Version of AEA MacRatt – MacRatt™ III

Advanced Electronic Applications, Inc., is now shipping the new AEA TNC control program. It has totally re-engineered the new MacRatt III to take advantage of the powerful features of the newer Macintosh operating systems.

This new software provides users with a simple, multifunctional terminal control program for the AEA TNC. On packet, each station you connect to will have its own adjustable split-screen window. Stream switching is automatic; just click your mouse on the window. A monitor/unproto window will display incoming packets. Unproto packets (to send CQ, for example) may even be sent while connected to others. For those TNCs with PACTOR, AMTOR, RTTY (Baudot & ASCII), Morse, etc., there are convenient interfaces built in to make these modes even more enjoyable to operate. Frequently used commands may be selected for the menus, dialog boxes, and buttons on the windows.

Suggested list price for MacRatt III is $99. Check with your amateur radio equipment dealer for the best price; upgrades for people who currently own MacRatt I or II are available only from AEA for $55.50. For details, call the 24-hour AEA Literature Line at (206) 712-8054; FAX them at (206) 775-2340; mailing address is AEA, P.O. Box C2160, Lynnwood, WA 98036.

New Stinger For Yellowjacket

Cubex proudly announces the Stinger, a new add-on supplement to its popular 2 meter "Yellowjacket" four-element quad antenna. The three-element Stinger is simply added to the director end of an existing Yellowjacket antenna, thus providing a solid seven-element quad antenna with 50% more gain than the Yellowjacket alone, without any special tools or tuning. The Stinger comes with a Fiberglas™ boom coupler and an aluminum boom/mast coupler plate.

The Stinger is $44.95 plus $7 shipping and handling; or $85.50 as a package with the Yellowjacket, plus $9 shipping and handling. It's available from the Cubex Quad Antenna Company, 2761 Saturn St. "E," Brea CA 92621. Phone (714) 577-9009 or FAX (714) 577-9124.

Continued on page 88

Ham Radio Fun

Communications Simplified, Part 6

by Peter A. Stark K2OAW
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Mt. Kisco NY 10549

Now that we've looked at wires and fiber optic cables for communicating, let's look at wireless communications—radio.

Is radio just high power?

Beginning students of communications sometimes think that transmitting a radio signal requires nothing but a lot of power. Are they right? Let's see.

Suppose you try the experiment shown in **Fig. 1.** Here we have a transmitter, which consists of a microphone feeding a high power audio amplifier (such as a hi-fi amplifier), and the output of the amplifier going to an antenna. The receiver is just another antenna, feeding a high gain audio amplifier (such as a hi-fi preamp) which takes the tiny signal received by the antenna, and amplifies it enough to feed a speaker. Would this work?

Some of our more advanced readers may laugh at the idea, but before they jump in, let me give you the answer: "YES! If you do it right."

The catch is that you need a big enough antenna. As a general rule of thumb, an efficient radio transmitting antenna has to be about a quarter of a wavelength long. You can make some compromises and make it smaller, but (except for some special loop antenna designs) this reduces its efficiency tremendously.

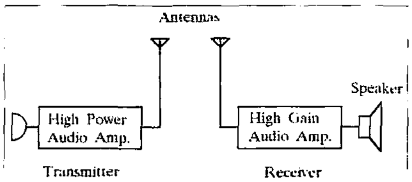

Fig. 1. Would this work for radio?

To transmit audio, let's assume we want to cover the frequency range from 20 to 20,000 Hz. Using the formula for the wavelength at 20 Hz, and using the speed of light in our equation, we get

λ = velocity/frequency = 186,000 miles per second/20 Hz = 9300 miles

An antenna one quarter wavelength long would then have to be 9300/4 = 2325 miles long!

Would it work? Sure, but would it be practical? Of course not! So how are we going to transmit a voice or music by radio?

To make radio practical, we have to shorten the antenna to some more reasonable length, and that requires that we shorten the wavelength. Looking at the above equation, we see that there are only two ways to do that: either reduce the speed of light (hmm...there's an idea there), or increase the frequency.

I suppose we could all learn to talk like the Chipmunks™ but this would not be enough. To reduce the antenna length a lot, we must increase the frequency *a lot*.

The solution to this problem is not to send the voice or music by itself at all, but to send a much higher frequency signal called the *carrier*, and to let the voice, music, picture, or whatever, ride on top of that carrier.

For example, if you look at the dial of an ordinary AM radio, you will see numbers ranging from 540 up to 1600. These numbers represent the frequencies of the carriers for the AM broadcast stations, which (for this type of radio) range from 540 kHz up to 1600 kHz.

One of the radio stations close to our school is WCBS in New York. It is about six miles from our campus, and we can pick up a very strong signal from them. Their carrier frequency is 880 kHz; let's see how long an antenna they need at this frequency:

λ = 186,000 miles per second/880 kHz = 0.21 mile

which is about 1,116 feet. A quarter-wavelength antenna would therefore have to be 1116/4 or about 279 feet long. WCBS's antenna is actually a vertical tower, somewhat over 250 feet tall. Rather than have an antenna mounted *on* the tower, the tower itself *is* the antenna. It is mounted on insulators, so it acts as a giant pole, pointing up to the sky.

Modulation

The process of putting our signal on a carrier is called *modulation*. In the transmitter, it is done by a *modulator*, and in the receiver our desired signal is removed from the carrier by a *demodulator*, also called a *detector*.

The carrier itself is a high frequency sine wave. Although the carriers for the standard AM broadcast stations are in the range of 540 to 1600 kHz, carrier frequencies can be much lower as well as much higher. The US Navy operates some transmitters with carrier frequencies about 10 kHz; on the other hand, microwave transmitters often have carriers above 10 GHz—that is more than 10,000,000,000 Hz.

Modulating a carrier involves changing it in step with the signal (voice, music, picture, or whatever, but we will talk only about audio for now) that we want to send. Since the carrier sine wave has a frequency, an amplitude, and a phase, any of these three can be changed with

modulation. When we change the amplitude, we produce *amplitude modulation* or AM, changing the frequency produces *frequency modulation* or FM, and changing the phase produces *phase modulation* or PM. We will begin by looking at AM, and leave FM and PM for later.

Amplitude Modulation (AM)

All of the radio stations on the standard AM broadcast band use amplitude modulation, a method which dates back to the very beginnings of radio.

Fig. 2 shows a sample of amplitude modulation. At the top, we see a typical audio signal. Underneath it is the *unmodulated carrier*, a plain sine wave with a much higher frequency than the audio signal; at the bottom is the carrier with the audio modulated onto it. Note how the modulated carrier (bottom waveform) becomes bigger when the audio is positive, and becomes smaller when the audio is negative. If the audio wave is near zero volts (right in the center of the audio wave), then the modulated carrier is the same height as the unmodulated carrier.

If you take a pencil and carefully connect the tops of each cycle in the modulated carrier, you get a curve that looks just like the audio signal. This is the dark curve in **Fig. 3**, and it is called the "envelope."

The modulator in the transmitter takes the audio and uses it to vary the amplitude of the carrier; the demodulator (detector) in the receiver then uses the envelope of the carrier to recover the audio, and throws the carrier away.

A simple AM receiver

Fig. 4 shows the diagram of a very simple AM receiver, called a *crystal radio*, that can be built at home with just a few parts. The unique thing about it is that it needs no battery or power supply, and so provides absolutely free radio reception, but since "there is no such thing

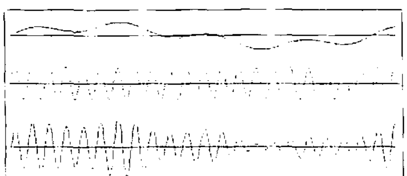

Fig. 2. Audio, carrier, and AM modulated wave.

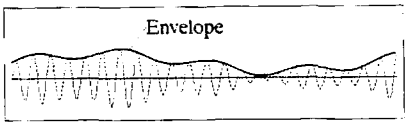

Fig. 3. The envelope.

as free lunch," there has to be a catch. The catch is that the radio really does need some power, and that power has to come from the radio station. This radio will only work if you are close enough to a radio station to receive a strong signal.

The antenna, a long length of wire preferably strung somewhere outside the house (but away from electric power wires), picks up many different signals, including AM and FM radio stations, TV stations, taxi and police radios, and more. The first thing to do is to remove the stations we don't want, and keep only the one we do want. This is done by a tuned circuit consisting of the antenna coil and the 365 µF variable capacitor; the antenna coil acts as both a transformer and an inductor in the tuned circuit.

Years ago, these two components were very easy to get in almost every radio store; today they are hard to find. Suitable replacements can be made from more modern parts, but it is probably easier to buy a commercial crystal radio kit, such as the one from Radio Shack™ (which uses a slightly different circuit, but it works the same way). When the right coil and capacitor combination is used, turning the capacitor from one end to the other will tune the radio through the 540 kHz to 1600 kHz range of the AM broadcast band.

Ideally, the output from the tuned circuit should contain only the modulated carrier from the one station we are tuned to; alas, that's not the way it usually works out. A single tuned circuit is usually not good enough to keep one station and remove all the others; a normal radio needs several tuned circuits working together to accomplish that. What usually happens in the crystal radio is that we have the one desired station, plus the signals from a few adjacent stations. If the station we want is strong and the others are weak, then the radio will work well, but if the desired station is weak and the others are strong, then we might as well give up—we will not be able to hear the station we want.

The modulated carrier is now sent to the diode. Since a diode conducts in only one direction, only half of the signal gets through it. In this case, only the positive peaks of the carrier make it through the diode. When these peaks hit the 0.001 µF capacitor, they charge it up (if you're familiar with power supplies, then you can think of the diode as the rectifier, and the capacitor as the filter which charges up to a DC value and removes the ripple). The capacitor basically charges to the voltage of the envelope. The voltage of the envelope keeps changing in step with the audio, and so the capacitor voltage also keeps changing. This voltage is then sent to the headphones.

Although the crystal radio circuit looks simple, actually all the components have to be just right, or it will not work properly. For example, the antenna coil and capacitor must be the right values to tune to the band; the ratio of turns also has to be right to give the maximum signal. For best reception, the diode should be a germanium diode, not a silicon one which needs more voltage to operate. The capacitor value is also somewhat important—it has to be large enough so it removes the carrier, but small enough so that it doesn't remove the audio signal (Actually, the radio will even work without this capacitor, but not quite as well). Even the headphones must be chosen carefully. They must have a high resistance (1000 ohms or more) to prevent shorting the signal; that means that the kind of headphone usually supplied with the "walk-person" type tape players will not work. In their crystal radio kit, Radio Shack omits the 0.001 µF capacitor, and uses a crystal headphone which has a very high resistance.

This kind of radio is called a crystal set because of the diode. Some 60 years ago, when crystal radios were very popular, tiny germanium or silicon diodes were not even invented yet. Instead, the crystal set used a small piece of galena crystal and a "cat's whisker."

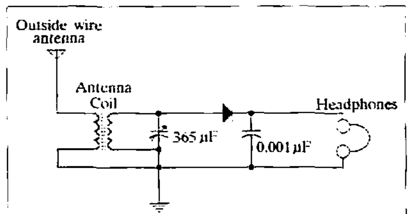

Fig. 4. A crystal radio receiver.

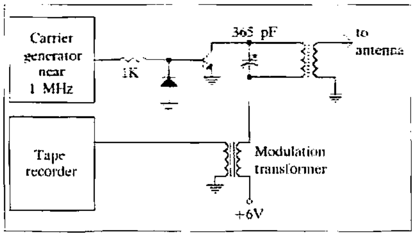

Fig. 5. A simple AM transmitter lab experiment.

The cat's whisker was a thin, springy wire which pressed against the galena to form a diode junction, and then was attached to a small handle with a knob. You had to probe the crystal to find a "hot spot." Tuning and adjusting such a radio was almost an art (and a lot of fun!)

A simple AM transmitter

Now that we see how the AM receiver works, let's see how the transmitter works. **Fig. 5** shows a simple circuit that our students wire in lab.

Rather than wire up our own oscillator, we use a commercial signal generator to generate a carrier. Our students first use a portable radio to find a clear spot on the dial, and then tune the generator to that open frequency, which is usually near 1 MHz.

The signal generator is fed to the base of the transistor. Since the transistor has no base bias, it only conducts when the generator's output is sufficiently positive (above about 0.7 volts) to bias it on. Thus, the transistor conducts only some of the time. But when it does conduct, there is enough voltage and current in the base to turn it on all the way.

The transistor, therefore, behaves like a switch, which is turned on and off roughly 1,000,000 times per second. This applies a square wave on-off current to the tuned circuit at the carrier frequency. As we have seen in previous installments, a square wave consists of a fundamental frequency plus harmonics. But the tuned circuit gets rid of the harmonics, so the signal going out to the antenna should (hopefully!) be just a sine wave at the carrier frequency.

The size (amplitude) of that sine wave depends on how much voltage gets switched by the transistor. Although the collector voltage supply is shown as +6 volts, the modulation transformer in series with the DC input changes that. When we play a tape on the recorder, the audio signal sent to the modulation transformer is alternately positive and negative, varying in step with the audio. The secondary voltage on the transformer is therefore also alternately positive and negative. When it's positive, it adds to the +6 volts to produce more voltage (and a bigger output carrier signal), and when it's negative, it subtracts from the +6 volts to produce less voltage (and therefore a smaller output carrier). In other words, the audio signal from the modulation transformer amplitude modulates the carrier.

Modulation percentage

There is a limit to how big that audio signal can get because when the transformer output reaches -5.9999 volts (or approximately -6 volts), it subtracts from the +6 volts to give almost zero; at this point, the signal becomes so tiny that it almost disappears. If the transformer output were to get even more negative (such as -7 or -8 volts), the collector would go negative, and the carrier would be shut off completely for a while.

The point where the signal just barely disappears is called 100% modulation, and is the maximum that we can vary the amplitude. At this point, the transformer output would have a maximum (peak) amplitude of ± 6 volts, so that the collector voltage would vary from its normal +6 volts all the way down to 0 volts, and up to a maximum of +12 volts.

100% modulation is a technical limit on how much you can modulate, but it is also a legal limit. If you tried to modulate more than 100%, your carrier would alternately go on and off; this would create a lot of interference to other stations, and the FCC would go after you for improper operation of your transmitter.

Fig. 6 shows a carrier with three different amounts of modulation: 0% (which is no modulation at all), 100% (which is the maximum permitted), and 50% (which is halfway between).

Actually, 100% modulation is just barely permitted, since it does cut off the carrier for an instant. Most AM transmitters are set up so they will use a maximum of perhaps 95% or 98% modulation, just to avoid the possibility of accidentally going over 100%.

Let's take a closer look at **Fig. 7**, which shows some unknown percentage of modulation. How can we figure out the actual percentage? It's actually quite simple. First, note that the maximum carrier voltage (called V_{max}) is 21.1 volts, while the minimum carrier voltage (called V_{min}) is 3.7 volts. Assuming symmetric modulation (meaning that the audio signal goes up the same amount as it goes down), this would place the average carrier voltage without modulation (shown as V_c at the left) halfway between the maximum and minimum. This is the average voltage, found from:

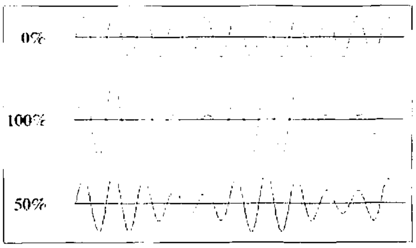

Fig. 6. Three different modulation percentages.

$$V_C = V_{max} + V_{min}/2 = 21.1 + 3.7/2 = 24.8/2 = 12.4 \text{ volts}$$

At the peak of the modulation, the voltage goes from 12.4 up to 21.1, which is an increase of (21.1 - 12.4) or 8.7 volts. At the valleys, the voltage goes from 12.4 down to 3.7, also a decrease of (12.4 - 3.7) or 8.7 volts.

To find the modulation percentage, we have to ask this question: A drop of 8.7 volts is how many percent of the maximum possible drop? The maximum possible drop (which is 100% modulation) is 12.4 volts, so 8.7 volts is what percentage of 12.4 volts? The formula is

$$8.7/12.4 \times 100\% = 70\%$$

So **Fig. 7** shows 70% modulation.

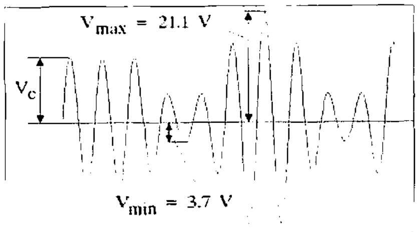

Fig. 7. Calculating the modulation percentage.

DETOUR

If you have, or can use, a PC-compatible computer, the following program lets you see a carrier with different percentages of modulation. It's written in Basic, and can run with either IBM Basic, GWBasic, QBasic, or Quick Basic:

```
10 'Program to display AM
20 PERCENT = 70 'Enter
percent here
30 SCREEN 2 : PRESET(0,100)
40 FOR X=0 TO 639
50 CARRIER = SIN(X/5)
60 AUDIO = SIN(X/50) *
PERCENT/100
70 TOTAL = (1 + AUDIO) *
CARRIER
80 Y = 100 + 40 * TOTAL
90 LINE -(X, Y)
100 NEXT X
110 IF INKEY$="" THEN 110
120 SCREEN 0
```

Enter the desired modulation percentage in line 20, and then run the program.

Line 30 of the program puts the display into graphics mode, and positions a black dot halfway down the left side of the screen. Lines 40 through 100 set up a loop to plot 640 dots across the width of the screen.

At each of the 640 positions, line 50 calculates a carrier voltage, line 60 calculates the audio (modulation) signal, and line 70 puts them together. By multiplying the two, it uses the value of the audio voltage to set the height of the carrier, and finally lines 80 and 90 calculate the height of the point on the screen and plot it. 73

END OF DETOUR

The BEARS Hunt the Fox

Motivate, mobilize, and make it fun!

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Looking for a great hands-on activity to motivate your students? Try a foxhunt! This multifaceted event encourages students to organize, research, experiment, construct equipment, and, most importantly, to have fun.

The Bethel Educational Amateur Radio Society, the BEARS, sponsored by the Technology Education Department of the Bethel Middle School, is designed to provide co-curricular amateur radio activities for our community's youth. It's an amateur radio organization in which the students are the primary focus and the adults serve as advisors.

The BEARS students constructed 2-meter loop antennas and learned about both foxhunting techniques and the importance of attenuators. The area was evaluated for good hiding places, sweep/search patterns were visualized, and a variety of safety-related issues were discussed. A group of students developed the rules and, on the appointed day and time, the foxhunt began.

"Some parents who came by to watch have since become licensed themselves, expanding the number of ham families in our community."

Photo A. Jason Strano N1JSW (l) and Bill Noyce N1LGU (r) check out a DF loop.

Many of the students got into the spirit by wearing military and camouflage clothes, which provided some hikers in the area with quite a thrill. Seeing the bustle of activity, they actually thought that this group was on a real search-and-rescue mission! Many people stopped by the Command Center to ask questions, and to request information on amateur radio licensing and classes.

The Fox Team was given a 15-minute head start. They used a dual-band HT for 2 meters and 220 MHz and a variety of antennas, from stubby ducks to a full-waver. They also had extra battery packs. The BEARS maintain the local 224.32 MHz repeater, so we were able to use 220 MHz as a backup and to coordinate events behind the scenes in case any problem cropped up. The 224.32 repeater has an autopatch, so we would be able to contact parents or emergency services if necessary.

It is important that a Fox Team have speaker-microphones or headsets, as in-close foxhunts require sharp hearing and you don't want to give away your position by talking loudly. While the Fox Team was getting ready to settle in, a review of rules took place, maps of the area were passed out, and an opportunity to address any last minute questions or concerns was provided.

In the interest of personal safety, all teams were comprised of three or four members. The more teams the merrier! Younger BEARS members were assigned to teams with at least one adult member.

"This multifaceted event encourages students to organize, research, experiment, construct equipment, and, most importantly, to have fun."

The hunt is on!

With the Fox Team safely hidden in the woods, the intrepid BEARS Foxhunter Teams took off in hot pursuit, antennas banging into tree branches and flying in all directions, each team wanting to be the first to trap the fox—nothing like a little pumped-up motivation to get this activity off on the right foot. This will also do wonders for one's cardiovascular conditioning.

Listening to the radio communications on simplex was quite humorous at times, with a seemingly endless stream of requests for the fox to send out transmissions and the fox replying with cryptic clues, in addition to taunting the hunters. It took nearly an hour, but the foxes were eventually captured. In the end, common sense pulled it out for the winning team. When the signals began to swamp their receivers, some participants removed their antennas completely and ran around the area, pointing their HTs in all directions, frustrated by the fact that they knew they were closing in on their prey. The foxes were hiding in plain sight, in the prone position, their camouflage clothing blending in with their leafy surroundings. The winners actually found the fox when they stepped on him! Within the next 10 minutes all teams were on target and accounted for.

Tired, hot, and physically exhausted, the first comment made was "CAN WE DO IT AGAIN?" You bet! The Foxhunt Committee is currently looking into new locations, encouraging students to construct or upgrade their equipment and foxhunting knowledge. All participants received a Certificate of Participation, which noted that this type of event supports skills that could be used by our local RACES/ARES organization.

Since our foxhunts began in the woods four years ago they have continued to garner a loyal following, with as many as eight teams participating. Doug Griffin WA1KRX put together an excellent "Foxhunting Basics" handout and has made presentations to the students, always allowing plenty of time for full question and answer sessions.

This activity is just the type of involvement that is readily accepted by youthful amateurs and students interested in our hobby. By taking full advantage of their needs, it provides a perfect way to acquire practical amateur radio experience, and have a good time as well. An additional bonus was that some of the parents who came by to watch the fun have become licensed hams, adding to the ever-increasing amateur group in our area. Having a parent become a licensed amateur offers a number of benefits to a child. It enhances a healthy parent/child relationship, and the student is assured of getting additional equipment as well as the opportunity to get that antenna hoisted up just a bit higher. This connection also provides the school club with additional human resources; chaperones and supervisors for future events, such as Field Day, simulated emergency tests, and other public service/training events. 73

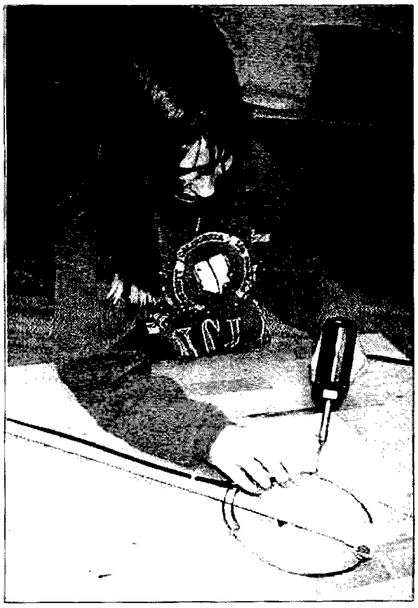

Photo B. Elizabeth Noyce N1OAN soldering a VHF loop antenna in preparation for a foxhunt.

Photo C. Dan Settanni N1MFG (l) and Bill Noyce N1LGU (r) test a commercially constructed DF unit.

Dealing With Doublespeak

Interpreting those befuddling transceiver spec sheets.

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Interpreting the specifications sheets used by ham radio equipment manufacturers to describe the technical advantages of their radios can often be a trying exercise. It seems as though the manufacturers have gone overboard to make them sound impressive, but it's sometimes tough to ferret out the *real* information. Mass-marketing techniques have definitely invaded the Hallowed Halls of ham advertising, using glitzy ploys previously associated with the guy or gal on-the-street consumer markets! As this trend grows, it's even more important for all of us to understand some of the finer points in the interpretation of technical specifications—more so than in years past.

Keep in mind that this treatment is intended to help clarify the numbers and acronyms used to describe amateur transceivers, not to make matters worse! So I'll attempt to use non-intimidating, readily understood terms—which, to some, may seem incomplete—but which, hopefully, will be understood by those at whom the article is aimed.

"If connecting a resonant antenna results in a background noise increase, a preamp will only bring up more background noise."

The following list contains most of the parameters quoted in the bulk of the transceiver manufacturers' technical spec sheets. I hope that I've covered those important for making purchasing and/or operating convenience decisions, but inevitably someone's favorite will be left out. Let me know—calmly, please—if that's the case.

Sensitivity

Sensitivity is a figure applied to radio frequency receivers indicating how little signal is needed at the set's antenna terminals (or coax input connector) for a minimum incoming signal to be at least "mostly" readable. It's usually referenced against so many decibels of quieting above the noise—generally 10dB. Since sensitivity is given as a voltage figure, 0.25μV for 10dB signal-to-noise ratio means that 1/4 of a microvolt at the antenna connector will produce a signal a little over 3 times the level of the background noise, a fairly typical figure. 6dB would represent a doubling of the voltage, 12dB a quadrupling of it, so 10dB would fall toward the high side of in-between, or 3.17 times.

Important: A dB of power is different from a dB of voltage; in power terms, 3dB represents a doubling and 6dB, a quadrupling of the power. In voltage terms, remember, 6dB represented a doubling and 12dB a quadrupling of the voltage (as mentioned in the previous paragraph). Nice of them to do that, but actually it's unavoidable, because power is the product of voltage and current. I mention it here so that it's not a surprise when we start to talk about power shortly.

Keep in mind that an increase or decrease in decibel terms is a ratio, and purely a logarithmic ratio, rather than a linear relationship. I think that's why many people shy away from using the dB concept, but it's not really that difficult. Using logarithmic ratios has two distinct advantages: Our senses work on a more-or-less logarithmic scale, and logarithms can be added together with the result being the same as if we had multiplied the actual numbers represented by the logarithms. Take a quick look at the sidebar chart to see how the logarithmic ratios for power and those for voltage relate. The chart also shows why it's important to figure out if the specs are speaking in terms of power or voltage, because the numbers can change quite a bit depending on the choice...and it's not always made totally clear by the specification writer.

Sensitivity, by the way, like most good things, can be overdone under certain local listening conditions. For instance, if you have a ham neighbor nearby, too much receiver sensitivity can result in overload products being developed—and those products are developed within your own receiver if it's too sensitive! In other words, a more sensitive receiver can usually be overloaded more quickly than a less sensitive one; that's the purpose of the attenuator switch found on many sets. It allows a person to deliberately make the receiver temporarily less sensitive—by a fixed number of decibels—if an overload is anticipated or is already taking place. Sometimes the RF gain control can also be effectively used for the same purpose or in conjunction with the attenuator switch.

Another point that's sometimes overlooked with regard to sensitivity is that if the background noise, with the antenna connected, is already above the noise generated within your receiver, more sensitivity won't help. It will only increase that external background noise even more. If connecting a resonant antenna to your receiver increases the noise from the speaker, then you probably won't benefit from additional sensitivity. Most modern receivers and transceivers generally have enough gain in the HF (below 30 MHz) portion of the spectrum so that they don't need additional help. Here are some of the common figures you'll see for a modern receiver or transceiver in the area of sensitivity (all for a 10dB signal-to-noise ratio): 1μV (1 microvolt) is common below the AM broadcast band,

4µV within the AM broadcast band and .25µV above the AM broadcast band through 10 meters. VHF and UHF receivers will sometimes benefit from some help, such as might be attainable via a low-noise preamp, because internally generated noise is more a problem at these frequencies. Again, it also depends upon the amount of local "normal" background noise present. 0.2µV or better in a 2 meter receiver is reasonable, but the lower the noise generated in the RF amp or preamp itself, the better. GaAsFETs are good performers in the VHF/UHF ranges and add-on preamps will usually be rated as so many dB of gain at such-and-such dB noise figure. Again, the lower the noise figure, the better; it's usually more important than gain at these frequencies. Obviously, though, an amplifier must have *some* gain to be an amplifier. A GaAsFET preamp will probably have less than 1dB noise for 15dB gain. So if connecting a resonant antenna results in a background noise increase, a preamp won't do anything other than bring up the background noise some more. The only time that this might be advantageous is if your receiver's AGC (Automatic Gain Control) circuitry is somehow lacking. In some receivers, more front end gain will improve the "AGC action," that is, the ability of the AGC circuit to maintain a "constant" output level with widely varying input signals. I've run into this in a couple of specific receivers. It may be due to insufficient RF gain, IF gain, or a problem in the design of the AGC circuit itself, but whatever the reason, adding a preamp can be a "quick fix" for a more complex design problem.

"Even a chain-link fence in the near field pattern of your antenna can generate harmonics, and they can be picked up on other frequencies!"

Selectivity

Selectivity is the figure used to indicate how well a receiver is able to separate one nearby signal (nearby in frequency) from another. It's usually determined, in modern sets, by the bandwidth of the crystal filters installed in the receiver's IF circuitry. These days they're pretty good. On SSB, the voltage gain may be down 6dB (a factor of 2:1) at 2.5kHz, while at 4.5kHz, it's probably down some 60dB (a factor of 1000:1). This is called "skirt selectivity," because the sides of the response curve slope downward much like the shape of a woman's skirt. The faster the slope, the better. Mini-skirts are better yet—no, that's another thought!

Narrower-than-normal filters are usually offered as options for "improved" CW, AM and SSB selectivity in today's transceivers. Keep in mind that "improved" selectivity means narrower frequency response and more critical tuning, so they may not seem to be improvements from every user's standpoint. Tighter selectivity will cut down on interfering signals, without question, but they also alter the "naturalness" of the final sound to some degree—sometimes to too great a degree, but it's a personal preference. IF shift—shifting the received signal within the receiver's intermediate frequency passband—is another, often less drastic way to cut down on interference. To my ear it's not as "limiting" as tighter selectivity for SSB reception. It's an arguable point. I'm not a big fan of reduced selectivity for the voice modes, because of the limitations on intelligibility, but for CW and Data, it's often a "must" on our crowded HF ham bands.

Emissions and harmonics

Spurious emissions and harmonic content refers to the number and strength of harmonics or other unintended (unwanted) signals emanating from a individual's transmitter. Most modern transceivers are quite good, listing figures of more than 40 to 50dB down in terms of harmonic output. It's a power ratio, by the way, so -40dB is 10,000 times down; -50dB would be 100,000 times down from the rated output power in watts. That translates into .01 watt (10 milliwatts) to .001 watt (1 milliwatt) of harmonic output for a 100 watt transceiver. They have to be that good to pass FCC guidelines for sale in this country, but there are things that a ham can inadvertently do to "degrade" the manufacturer's attempts to keep these unwanted products as low as possible.

Keep in mind that anything added to the transmission line after the basic transmitter or transceiver—such as an SWR bridge or a linear amplifier—can degrade those figures. SWR bridges have diodes that can sometimes create harmonics that weren't there before, and amplifiers can run nonlinear if overdriven to varying degrees. Need something to keep you awake nights? Even rusty crossover points in a chain-link fence, in the near-field pattern of your antenna, can generate harmonics by iron oxide diode action, and they can be picked up by nearby receivers tuned to other frequencies! It is incumbent upon the licensed operator to correct or minimize unwanted emissions, regardless of origin.

Spurious response

Spurious response is the measure of a receiver's ability to handle a strong local signal and to not generate unwanted byproducts as a result of that exceptionally strong signal. Take another look at the discussion on receiver overloading under the topic of sensitivity above. There are inherent design approaches that a receiver manufacturer can take—including the choice of components in the first stages (the RF amp and mixer stages) of the receiver—to minimize this

Specifications

General

Rx frequency range: 100 kHz - 30 MHz

Tx frequency ranges: 160 -10m amateur bands only

Freq. Stability: < ± 10 ppm (-10 ~ +50°C)
< ± 2.0 ppm (0° ~ +50°C) w/TCXO-4
< ± 0.5 ppm (0° ~ +50°C) w/TCXO-6

Freq. Accuracy: < ± 7 ppm (except FM, < ± 500 Hz)
w/TCXO-4: < ±2 ppm (FM < ± 460 Hz)
w/TCXO-6 < ± 0.5 ppm (FM < ± 500 Hz)

Operating temperature Range:(-10° ~ +50°C)

Emission modes: LSB, USB, CW, FSK, AM, FM

Frequency steps: 0.625/1.25/2.5/5/10 Hz for SSB, CW, RTTY & Packet; 100 Hz for AM and FM

Antenna impedance: 50Ω unbalanced

Power consumption:

Input	Rx (no signal)	Rx (signal)	Tx (100W)
100~125 VAC	70 VA	80 VA	550 VA
200~240 VAC	80 VA	90 VA	600 VA
13.8 VDC	2.4 A	2.8 A	19 A

Supply voltage: 100~125, 200~234 VAC, 50/60 Hz

Dimensions (WHD): 410 x 135 x 347 mm

Weight (approx.): 15 kg. (33 lbs)

tendency. IF rejection and image ratio are included under this general heading, though they may he stated separately, and good figures (in voltage terms) are -70dB or better, which is in the order of a 3000:1 reduction, voltage-wise.

Other parameters

Squelch sensitivity used to be generally thought of in terms of FM receivers only, but many SSB/CW receivers today also have squelch capabilities. In general, squelch sensitivity refers to the minimum signal required to "open" the receiver's squelch circuit, allowing the operator to hear a call from another station. The setting of the squelch control itself, of course, will also affect the ultimate sensitivity of the receiver to "open up" upon the presence of a valid signal, but the absolute minimum signal needed is a factor that's built into the receiver's capabilities. Many show figures of .25µV (1/4 of a microvolt) or less, which is quite sensitive.

Carrier suppression refers to how far down the unwanted carrier, in single-sideband, is from the carrier in, say, the CW key-down position. Getting rid of as much of the carrier as possible is the idea, since the carrier contributes nothing to an SSB signal, other than perhaps more QRM if it's too high. Today's balanced modulators easily cut the carrier down to -40dB or more, a factor of 10,000:1 or better. That's still .01 watt (10 milliwatts) of carrier for a 100 watt transceiver, which explains why you'll often hear some carrier from a nearby station.

Unwanted sideband suppression is pretty much a factor of the selectivity of the fixed crystal filter used to filter out the unwanted sideband in an SSB signal. It's done at a low power stage and generally runs better than -40dB, about the same as the carrier suppression. And for the same reason as good carrier suppression is important, good sideband suppression lowers unnecessary QRM on the bands.

Frequency stability is generally very good today, compared with the Tube Era, but it still varies from one transceiver model to another. Within plus or minus 200Hz over a 30-minute period and plus or minus 30Hz thereafter are common figures. The less drift, obviously, the better, but you must reasonably expect *some*. Individual transceivers of a particular model number may be slightly better or worse; the manufacturer publishes averages. Keeping the transceiver cool with adequate air circulation helps a great deal. Power supply regulation can also be a factor, when using an external power supply, but today's voltage regulators are excellent as long as the supply isn't overloaded. Battery operation, without the benefit of recharging the battery, may be one area where frequency stability can suffer, even today. You can reach a point where the regulators in the transceiver no longer have enough "head-room" voltage to work with—I've heard it a few times from stations running from emergency battery power only.

"The human factor counts—some mikes sound very different depending on who's speaking."

Microphone input sensitivity and impedance are two specifications that are sometimes glossed over, but they can be important if you're not using the microphone made to match a specific transceiver. Here's why: Amateur transceivers can vary a fair amount in their audio input impedances. Back in the all-tube era, ham transmitters had "high impedance" mike inputs—100k to 1 megohm. The switch to solid-state transceivers saw mike inputs in the "medium impedance" (2k to 10k ohm) and "low impedance" (500 to 2k ohm) ranges; most fall into the "low impedance" spread these days. Transceivers also vary in their input audio sensitivity, from -80dBm to perhaps as high as -20dBm (dBm is a standard of 1 milliwatt into 600 ohms). Of course, the mike plug, its wiring, and whether the audio "ground" and PTT "ground" are the same point within the transceiver's internal circuitry will vary from manufacturer to manufacturer.

Often, the choice of microphone can make a substantial difference. It depends upon the frequency response of the mike itself, the internally-determined audio frequency response of the transceiver and the individual voice characteristics of a particular operator. How the operator handles the mike (mouth-to-mike distance and the strength of his voice) are also factors; some mikes sound quite different when "close-talked." All of the other specifications we've mentioned are moot if the person on the mike can't be heard at the other end of the circuit!

If you intend to use an existing mike with a new transceiver, it's best to check the specs of the new radio against those of the existing mike to be sure that they're compatible from an output level and impedance standpoint. An *exact* impedance match isn't necessary, since most transceivers have a microphone gain control to compensate for inequalities in the various mike outputs and human voice-loudness differences, but you'll need to be in the right ballpark. It's also important to have the correct DC voltage available at the mike connector for driving an electret mike's built-in FET preamp, if that's the type of mike you intend to use.

Audio power output and impedance indicates the amount of audio driving power that can be expected to be developed into a particular speaker load impedance without developing more than a certain percentage of distortion. A typical figure for an HF transceiver would be 1 to 1-1/2 watts, at 10% or less distortion, into a 4-ohm speaker. That will fill your shack with more 20 meter chatter than you'll probably tolerate for very long! Hand-held transceivers will put out only a half watt or so of audio at 10% distortion, but it's enough to make the small internal speaker in an HT begin to rattle. Audio power, output power, and impedance are more important if you intend to run extension speakers to other locations, or if you're using a relatively inefficient external speaker that may require more driving power.

Final power is something that shouldn't be confusing, but often is. In HF transceivers, it's usually given in PEP (Peak Envelope Power), input power in watts for SSB, and DC input power in watts for CW, FM and AM. Some VHF/UHF transceivers have chosen to state the output wattage instead. In cases where the RF power is stated in input terms, the output to your antenna (or linear amp) will generally be only 50 to 60% of that input figure; that's the conversion loss experienced between input DC power and output RF power. A transceiver that quotes 200 watts DC-CW key-down power input will actually read about 100 to 120 watts on a

WATTAGE	VOLTAGE
+100dB = 10,000,000,000	+100dB = 100,000:1
+90dB = 1,000,000,000:1 (1 billion to 1)	+90dB = 31,700:1
+80dB = 100,000,000:1	+80dB = 10,000:1
+70dB = 10,000,000:1	+70dB = 3,170:1
+60dB = 1,000,000:1 (1 million to 1)	+60dB = 1,000:1
+50dB = 100,000:1	+50dB = 317:1
+40dB = 10,000:1	+40dB = 100:1
+30dB = 1,000:1 (1 thousand to 1)	+30dB = 31.7:1
+20dB = 100:1	+20dB = 10:1
+10dB = 10:1	+10dB = 3.17:1
0dB = 1:1	0dB = 1:1

***Table 1.** This chart might be a handy thing to keep nearby for the numerical ratios you'll need to know.*

wattmeter connected directly to its output, when the transceiver is connected to its proper terminating impedance (usually 50 ohms). The FM and AM outputs are often considerably less. By the way, the FCC considers you responsible for knowing your output PEP (Peak Envelope Power)...if you're operating anywhere near the legal limit—and the legal limit is just 200 watts PEP on certain bands and subbands. Peak Envelope Power output is different (greater) than CW key-down power output; it must be measured because of differences in individual voices, speech circuits, speech processors, microphones, etc. Take a look at a recent copy of the FCC Rule Book for the entire story. Peak Envelope Power must be read with a scope or a PEP meter. The average wattmeter may not be fast enough to catch the peaks in the RF envelope.

Power requirements will either be quoted in terms of 120 volts or 240 volts AC, at so many watts, in the case of a transceiver with a built-in AC power supply. For transceivers intended to work from "12 volts DC," the normal CW key-down amperage will be given for the transmit mode and the "normal listening level" current for the receive mode. Make sure that the 12 volt power supply (if one is used), its wiring, fuses, and any connectors in the circuit will safely carry the expected maximum current drain.

Here's another point to keep in mind: The commonly used term "12 volts DC" probably means 13.8 volts DC. Why? Because 13.8 volts is what a fully charged lead-acid (automobile) battery can be expected to deliver. During charging, that figure may rise to 14.4 volts. It's important because if that is the voltage level that the manufacturer uses in his specifications, then your fixed-station, low-voltage, high-current power supply should also deliver that 13.8 volt figure. Some transceivers won't regulate properly internally with much less in the way of terminal voltage. Try to measure the transceiver's input low-voltage right at the rear apron power connector, under full CW key-down load, to give you a better idea of the true DC voltage input.

Et cetera

Most of the other specs listed in the literature are more or less obvious, transmit/receive frequency range, antenna impedance, modulation type/s, number of IF conversions and the IF frequencies used, etc. They rarely require much translation. Most of us get hung up on the decibel business, so I've concentrated on those specifications more, with others that I felt were of importance added to the discussion.

Some additional thoughts

It's possible that some of the most important specifications aren't even given...at least those that I feel are pretty important. I'd like to see a typical frequency response curve for the transmitter's audio section, so that I'll know where to start if I receive reports dio sounds "tinny," or too "bassy." On the same topic, I'd like to see a response curve for the receiver's audio circuits. I've heard of receivers that can cause operator fatigue, over a long operating period, simply because their receiver audio chain wasn't designed for overall listener comfort. I would also like to see a figure on the minimum DC input voltage that's allowable into a transceiver, when the internal voltage regulators begin to lose control, as discussed under the power requirements section above. More information on AGC attack times and recovery rates would also be helpful—these are usually only apparent after operating a transceiver for a while. Smoothness of tuning and accessibility of often-used controls are also important features. The "logic" of how memories are stored and retrieved can make operating any particular transceiver either a pleasure or a chore (there are those of us who still like a button that does just one thing, and is clearly marked as to what that one thing is).

Admittedly, some of these are "human-engineering" issues, which are often difficult to phrase for data sheets, but they're issues that can make or break a particular model's acceptability in the "real-world" marketplace. Rest assured that the manufacturer will inevitably promote the best features and avoid those that might prove to be embarrassing; I suppose that's only natural.

Phrases like Auto Correlation and Adaptive Digital Filtering are just now beginning to appear in advertising literature, but be prepared for an onslaught of new multi-initialed acronyms...then try to understand what they're really saying. The smoke hasn't begun to clear yet, but I hope that the various transceiver manufacturers can get together on what to call things and on what are the issues important to the rest of us out here. Until then, the Decimation Aliasing and Correlation Products will keep us Quantizing the transceiver ads! Rough translation: We'll keep trying to wade through the number of confusing ads and repetitive word-speak, to a finite number of specifications having some degree of precision in their common usage.

In the meantime, remember that anytime you're reading specs, try to determine whether the writer is talking in terms of

voltage (two times increase = 6dB) or wattage (two times increase = 3dB)...it can make a world of difference in what the real specification means. It isn't always easy to determine, nor is the reference dB that the writer might be using always the accepted standard, but most specs are referenced against: 1 milliwatt into 600 ohms for wattage (called a dBm) and 773 millivolts into 600 ohms for voltage (called a dBV). For true dB gain comparisons, the input and output impedances must also be equal.

See the sidebar chart for decibel (dB) ratios from zero dB to 100dB for both wattage and voltage. Notice the logarithmic rise in both, but differing for wattage and voltage.

The same ratios apply in the negative direction when calculating dB below zero. As an example: a +60dB increase in wattage would be a 1 million to 1 increase, a -60dB decrease in voltage would be a 1,000 to 1 decrease.

FYI: Please send 73 your filled-out Feedback card...73 Magazine values your input...(plus there's a drawing from the cards received for a free subscription too.) Tnx. Last month's winner: Phil Licwinko of PA.

Number 76 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits.Please send us your Special Events two months in advance of the issue you want it to appear in .For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your special event.

MAY 26

WEST FRIENDSHIP, MD The Maryland FM Assn. will hold their Hamfest al Howard County Fairgrounds. Talk-in on 146.76, 224.76, and 444.00. Contact *Melvin Seyle WA3KZR, 15809 Pointer Ridge Dr., Bowie MD 20716. Tel. (301) 249-6147.*

MAY 31, JUN 1–2

ROCHESTER, NY The Rochester Hamfest and Computer Show, combined with the New York State Atlantic Div./ARRL Convention, will be held at Monroe County Fairgrounds, Route 15A. Schedule: Fri., May 31st: 6 AM Outdoor Flea Market. 6:30 PM: Annual Banquet. Sat., Jun. 1st: 8:30 AM–5:30 PM: Exhibit Hall Open. Sun., Jun. 2nd: 8:30 AM–1:30 PM: Exhibit Hall Open. 1 PM: Grand Award. The outdoor Flea Market runs continuously all weekend. Accommodations at the Rochester Marriott Thruway Inn, P.O. Box 20551, Rochester NY 14602; Tel. (716) 359-1800. You MUST tell them you are with the Rochester Hamfest. For accommodations at other hotels, airline tickets, car rentals, call the Hamfest official travel agency, Gallery of Travel, (800) 724-2046 or (716) 427-0920. There is no charge for the agency services. Talk-in Rptr.: 146.28/.88. Contact during business hours, *(716) 424-7184.* For ticket info, call *(716) 671-4430 before 9 PM.Internet:http:// www.vivanet.com/-rochfst/hf/ main96.html.Email: rochfst@vivanet.com.*

JUN 1

FRIENDSHIP, WI A Spring Hamfest will be hosted by the Adams County ARC, 8 AM–2 PM al Adams County Fairgrounds. Setup is at 7 AM. VE Exams. Tailgate selling area available. For details, contact *Adams County ARC, P.O. Box 232, Friendship WI 53934. Tel. (608) 564-7887; Packet: N9TD-1 on 145.03.* Talk-in on 145.29 Adams Rptr.

LOVELAND, CO The Northern Colorado ARC will sponsor "NCARC Superfest" at the Larimer County Fairgrounds, 700 S. Railroad, 8 AM–3 PM. Talk-in on 144.515/.115 PL 100; or 146.25/.85. For VE Exam and table info, call *Jeanene Gage NØYHY, (303) 351-7327.* For general info, call *Michael Robinson AAØUB at (970) 282-1167.*

SPRINGFIELD, IL A Hamfest sponsored by Sangamon Valley RC will be held at Illinois State Fairgrounds, 4-H building, 8 AM–1 PM. FLEA Market. VE Exams at 9 AM. Talk-in on 147.315, 224.68, and 444.75 (all -103.5 Hz tone). Contact *Don Pitchford WD9EBK, RR#1 Box 104, Springfield IL 62707. Tel. (217) 789-4519.*

TEANECK, NJ The Bergen ARA will hold its annual Spring Hamfest at Fairleigh Dickinson Univ. Flea Market, reservations required for power. The VE Exams contact is *Bob Neukomm, (201) 427-3568 before 10 PM.* Hamfest contact is *Jim Joyce, (201) 664-6727.*

JUN 2

CHELSEA, MI The Chelsea ARC, Inc., will hold their 19th annual Hamfest/Swap 'N Swap at Chelsea Fairgrounds, starting at 8 AM. Setup is at 6 AM. Talk-in on 146.980 Club Rptr. No VE Exams. For more info, contact *Alan Robbins, 3800 Hooker Rd., Pinckney MI 48169. Tel. (313) 878-0363.*

CONTOOCOOK, NH The Contoocook Valley RC will hold a Flea Market starting at 8 AM, Exit 7 off I-89, 14 mi. NW of Concord. Talk-in on 146.895(-) or 146.94(-), and 146.52 simplex. For details, call *John Moore N1FOJ, (603) 746-4817; or Packet BBS: WA1ALM @ WA1WOK.*

CORAOPOLIS, PA The 42nd annual Breezeshooters Hamfest and Computer Show will be held at the Butler Farm Show Grounds. 8 AM–4 PM. Table selection is on a first-come-first-served basis, so apply today. Contact *George Artnak N3FXW, 3350 Appel Rd., Bethel Park PA 15102. Tel. (412) 854-5593.* Indoor tables must be reserved before May 20th. Product demos by ICOM America. Mobile check-in until 2 PM: 28.495 and 146.520 MHz. Talk-in on 147.96/.36 W3UDX Rptr., courtesy the Butler County ARA.

FENTON, MI A Hamfest/Computer Fair will be held by the Fenton Area ARA. 8 AM–2 PM, at Ben Sherman M.S., 14470 N. Holly Rd., Holly MI. Sat. night setup. Talk-in on 146.78(-). Reg. for VE Exams at 9:30 AM; sessions start at 10 AM. Contact *Marty WD8RCI at (810) 634-9826; FAX (810) 634-0866.* Mailing address is *F.A.A.R.A. Hamfest Committee, P.O. Box 46, Fenton MI 48430.*

MANASSAS, VA The Ole Virginia Hams ARC, Inc. will hold the "Manassas Hamfest Amateur Radio and Computer Show" at Prince William County Fairgrounds, 1/2 mi. south of Manassas, on Rte. 234. Tailgate setup 2 PM till 11 PM on Sat. Food venders must obtain prior written approval from the Hamfest Chairman. Dealers, call *Joe K4FPT, (703) 368-5424.* For general info, call *Mary Lu KB4EFP. (703) 369-2877*

JUN 8

BYRON CENTER, MI The annual IRA Hamfestival will be held at the Hudsonville Fairgrounds near Grand Rapids MI. Doors open at 8 AM; setup is June 7th after 8 PM, or after 6 AM on the 8th. Overnight camping available. VE Exams. Book reservations early if you are interested in indoor table space. Contact *Tom KA8YSM,* or *Kathy KB8KZH, at (616) 698-6627,* or write the *IRA, 562 92nd St. SE, Byron Center MI 49315.* Talk-in on 147.16 link Rptr. system.

KITCHENER, ONTARIO, CANADA The 22nd annual Central Ontario AR Fleamarket will be held at Bingeman Park. This event will be jointly sponsored by Guelph ARC and Kitchener-Waterloo ARC, Inc. Talk-in on 146.97(-), or 145.21(-). Contact *Ted Eaton VE3GJE, 102-21 Woodlawn Rd. E., Guelph Ont., Canada N1H 1G6. Tel. (519) 823-1027; Packet: VE3GJE@ VA3RWP.#SWON.ON.CA.NA. Internet:eeaton@sentex.net.*

RIVERDALE, NJ The annual North Jersey Hamfest, sponsored by Split Rock/West Morris Radio Clubs, will be held at the NJ Nat'l. Guard Armory on Newark Pompton Tpk. (Rte. 23). Talk-in on 146.985/.385 or 223.860/222.260 PL 136.50. Contact *Bernie WB2YOK, FAX/ Voice (201) 584-5399* any time; or *75503,3221@COMPUSERVE.COM.*

WINSTON-SALEM, NC The Forsyth ARC will host the Winston-Salem Hamfest, Computer and Electronics Fair at the Dixie Classic Fairgrounds beginning at 8 AM. Free camping Fri. night. RV hook ups available for a nominal fee. Open and covered tailgating. Dealer tables. Flea Market tables. ARRL VE Exams. Talk-in will be on the 146.64(-) Rptr. Visit our website at *http://www.rbdc.com/~kq4lo/ farc.htm.* Contact *Forsyth ARC, Inc., P.O. Box 11361, Winston-Salem NC 27116. Tel. (910) 723-7388. FAX: (910) 765-6656.*

JUN 8–9

ATLANTA, GA The 1996 Atlanta Hamfestival and ARRL Georgia State Convention will be held at City Hall East - Exhibition Center, 675 Ponce de Leon Ave. (across from Crackers' Ponce de Leon Park). Talk-in: W4DOC on 2 meters at 146.82. An Atlanta Police officer will provide on-site security for the nights of June 7th and 8th. Flea Market: Ham Gear, Computers, Electronics, Software, Parts, etc. VE Exams. Ladies Activities, and much more. For more details, see our display advertisement in this issue. Show hours: Sal. 9 AM–4 PM; Sun. 9 AM–3 PM. Contact Hamfest Chairman, Marty AA4RM, (404) 814-9304. For Commercial Booths, call Bill W4LFC at (770) 493-8438. You can find Hamfest info on the BBS at (770) 850-0546. Internet address: marty@aa4rm.radio.org.

JUN 9

COVINGTON, KY The Northern Kentucky ARC will hold "Ham-O-Rama '96" at the Erlanger Lions' Park. Indoor exhibit area. Outside Flea Market with setup at 6 AM. General admission begins at 8 AM. Provide your own tables. Contact *N8JMV, c/o NKARC, P.O. Box 1062, Covington KY 41012; or call (513) 797-7252 eves.* Talk-in on 147.255(+) or 147.375(+) Rptrs.

GRANITE CITY, IL The Egyptian Radio Club annual Egyptian Fest/ Hamfest, Computer Fair and Flea Market will be held at the Granite City Campus of Belleville Area College. 1/2 mile south of I-270 on Maryville Rd., 8 AM–1 PM. VE Exams. Indoor Dealer and Exhibit area. Talk-in on 146.79. Contact

Egyptian Radio Club, P.O. Box 562, Granite City, IL 62040; or call *Bill Dusenbery N9OQK, (618) 398-1456.*

MANCHESTER, MD The Hanover Area Hamming Assn. will present the Pleasant Hill Ham and Computer Show at Pleasant Hill Fire Co., 5 mi south of Hanover, on Rte. 94. The event starts at 8 AM. Talk-in on 146.895(-). VE Exams at 9:30 AM; contact *Bill NZ3J, (717) 359-7090,* or *Pat WW3U, (717) 632-4237.* Please pre-reg.

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St. Setup at 7:30 AM, buyers admitted at 9 AM. Talk-in on 444.200 WB2ZZO Rptr, 146.52 simplex. For info call *Arnie Schiffman WB2YXB, (718) 343-0172, eves.*

JUN 14–15

ALBANY, GA The 14th annual Albany ARC Hamfest and Georgia Computer Fair, (1995 ARRL Georgia Section Convention), will be held at the James H. Gray Civic Center, Oglethorpe Dr. (Hwy. 82) at the Flint River, Albany GA. Table fees include passes for workers. Pre-reg. before June 1st. VE Exams $6.05 per person (checks only, no cash accepted). Rooms for conducting radio and computer forums are free. No alcoholic beverages allowed. No "Adult Entertainment" type of materials allowed. Contact *William A. Shipley, (912) 439-2351 Ext. 15.* Mail payments to *Albany Amateur Radio Club, Inc., P.O. Box 70601, Albany GA 31708-0601.*

JUN 14–16

RED DEER, ALBERTA, CANADA The Central Alberta Radio League will host its 26th annual Picnic and Hamfest at the Burbank Campsite (about 8 km NE of Red Deer). There will be many activities and displays. Contact *Bob VE6BLD, 5540 54th Ave., Lacombe, Alberta, T4L 1L6. Tel. (403) 782-3438. Packet VE6BLD @ VE6RDR.AB.CAN.*

JUN 15

BLUEFIELD, VA Bluefield Hamfest, Inc. will sponsor the Bluefield Hamfest and Computer Fair, 9 AM–3 PM, at the Graham M.S. VE Exams at 9 AM at the Hamfest site. Walk ins accepted. Talk-in on 145.49 (BR549) Rptr. For more info, send SASE to *Bluefield Hamfest, Inc., 412 Ridgeway Dr., Bluefield VA 24605-1630;* or call *Don Williams WA4K, (540) 326-3338.*

DUNELLEN, NJ Raritan Valley Radio Club will present its "96 Hamfest" at Columbia Park near the intersection of Rte. 529 and 28, 7 AM–2 PM. Talk-in on 146.625(r)/.520(s)l. For details, contact *John Manna WA2Fi at (908) 722-9045;* or *Bob Pearson WB2CVL, (908) 846-2056.* To pre-reg., call *Guy Glaser (908) 968-0297* (all before 8 PM).

JUN 16

DYER, IN The Lake County AR Club will hold their 24th annual Dad's Day Hamfest at the Lake County Fairgrounds in Crown Point IN. Doors open at 6 AM for vendors and 8 AM for the public. VE Exams at 9 AM. Talk-in will be on 147.000(+). Contact *Dave Snell N9WLP, 833 Schilling Dr., Dyer IN 46311. Tel. (219) 865-6131.*

MONROE, MI The Monroe County Radio Comm. Assn. will host the Monroe Hamfest at Monroe County Fairgrounds, M-50 at Raisinville Rd. Please contact *Fred VanDaele, 4 Carl Dr., Monroe MI 48162. Tel. (313) 242-9487.*

JUN 20

RICHMOND, IN A Fly-in, Drive-in Hamfest/Computer Show will be held 8 AM–3 PM at Richmond Municipal Airport. Setup 3 PM–5 PM June 29th and 6 AM–8 AM June 30th. Commercial vendors and Flea Market. Talk-in on 147.270/.870. Contact *Ken KB9VO* or *Janet KB9UP, 3425 Woods Dr., Richmond IN 47374. Tel. (317) 935-2853.*

JUN 28–30

RAPID CITY, SD The Black Hills ARC will host a Hamfest at Surbeck Center on the campus of SD School of Mines & Tech., 501 E. St. Joseph St. Flea Market. AR equip. vendors. VE Exams. QCWA Meeting. Forums. Pre-reg. is $8 before June 1, via *P.O. 294, Rapid City SD 57709.* Include SASE for confirmation and details.

JUN 30

WHEATON, IL The Six Meter Club of Chicago, Inc. will present their 39th annual Hamfest at the DuPage County Fairgrounds, 2015 Manchester Rd. Gates open at 7 AM. General parking at West Gate; Sellers only at East Gate. Talk-in on K9ONA 146.52; K9ONA/R 146.37/.97 (107.2). No alcoholic beverages permitted. For info, call the 24-hour InfoLine: (708) 442-4961. Make checks payable to Six Meter Club of Chicago, and SASE to *Six Meter Club of Chicago, 7109 Blackburn Ave., Downers Grove IL 60516,* no later than June 10th.

JUL 6

SALISBURY, NC The North Carolina Alligators Group will hold their Firecracker Hamfest at Salisbury Civic Cenler, 8 AM–1 PM. Setup at 7 AM Sat., or 3 PM–9 PM Fri. Talk-in on 146.730. Contact *Walter Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC 28071. Tel. (704) 279-3391.*

SPECIAL EVENT STATIONS

MAY 27

ALTON, IL The Lewis and Clark Radio Club will operate KG9DD 1400 UTC–2000 UTC in commemoration of the Alton Memorial Day parade, which has been held every year since 1869. Freq.: 7.265, 14.265, 21.375, 28.400. For a certificate, send name, address and QSL to *Dennis Tuchalski N9WDQ, 2300 Morning Star Dr., Alton IL 62002-5623 USA.*

JUN 1

LA GRANGE PARK, IL The Six Meter Club of Chicago, Inc. will operate K9ONA from 1400 UTC–2200 UTC to commemorate the 50th Anniversary of the La Grange IL Pet Parade. Look for K9ONA on the lower portions of the General phone sub-bands, 40 through 10 meters, and on the 146.37/.97 K9ONA Rptr. (107.2 Hz). A special QSL card will be available for an SASE to *Karl Weisshappel WA9CCO; 820 Barnsdale Rd., La Grange Park IL 60526 USA.*

MT. CARMEL, IL The Radio Amateur Downstate Illinois Org. will operate club station WD9GTW, 1500 UTC–2200 UTC at the Mt. Carmel Airport Appreciation Days. Operation will be on the General phone subbands on 15, 20, and 40m; 28490 on 10m; and 146.940 Mt. Carmel Rplr. For a certificate, send SASE with QSL to *R.A.D.I.O., 827 Broadmoor, Mt. Carmel IL 62863 USA.* For info call *(618) 262-7111.*

NEW PORT RICHEY, FL The Pasco County RACES will operate Station KD4TLQ during the 2nd annual Hurricane Expo. Operation will be on the lower portion of the General band of the 20, 40 meter phone subband 1400Z–1900Z. For a certificate, please send a QSL and SASE to *Pasco County Office of Disaster Preparedness, 7530 Little Rd., Emergency Communications Center, New Port Richey FL 34654.*

JUN 8

MANCHESTER, NH THE Amoskeag RC will operate Station KB1BQK 1200 UTC2000 UTC, in celebration of the Manchester NH Sesquicentennial. The Station will be operated at Derryfield Park. Freq.: near 20m/14.245, 15m/21.045, 40m/7.245, 40m/7.035 CW. QSLs upon contact and request to *Amoskeag Radio Club, P.O. Box 996, Manchester NH 03105 USA. Contact person: Al Stewart N1SMB, (603) 622-4712, or NONESMB@AOL.COM.*

JUN 8–9

FULTON, NY The Oswego County Amateur Radio Emergency Service, ARES, will operate KY2F June 8th and 9th. 1200Z–2000Z each day during the Experimental Aircraft Assn's Young Eagles Days. The Oswego county Airport is the location for this event. Operation will be in the lower half of the General 80, 40, 20, 15 and 10 meter phone bands. for a certificate, send your QSL card and a large SASE to *Fred Swiatlowski KY2F, P.O. Box 5281, Oswego NY 13126 USA.*

JUN 15–16

DAYTON, OH Station KB8JUA will operate in celebration of Dayton's bicentennial. Operation will be 1500Z–2200Z. CW–7.125, 14.125, 21.125, 28.125. Phone–7.275, 14.275, 21.375, 28.475. For a certificate, send a 9x12 SASE to *Mike Priest KB8JUA, 626 Creighton Ave., Dayton OH 45410 USA.*

DEARBORN, MI The Garden City ARC will operate KC8BEB 1400Z–2000Z June 15th and 16th to commemorate the American Automobile Centennial, from the Henry Ford Museum and Greenfield Village. Freq.: 7.255, 14.255, 21.330, and 28.380. For a certificate, send a #10 SASE to *G.C.A.R.C., P.O. Box 482, Garden City MI 48135 USA.*

JUN 22–23

SONOMA, CA The Valley of the Moon ARC will operate Station WB6DWY during Field Day from 1500 UTC on the 22nd–0400 UTC on the 23rd. The event will celebrate the Sonoma sesquicentennial festivities, marking the 150th Anniversary of the Bear Flag Revolt, which led to California's independence from Mexico. Freq.: (+/-) 7.250, 14.250 and 21.350 MHZ SSB. A commemorative QSL card will be offered to all stations confirming contact during the event with a QSL card. QSL to *WB6DWY, 358 Patten St., Sonoma CA 95476.* For more info, contact *Darrel Jones WB6BOR at (707) 996-4494.*

JUN 29

CHITTENANGO, NY The Madison/ Oneida ARC will operate Station KB2UDX 0900–1730 EDT at the Chittenango Landing Canal Boat Museum, in celebration of the museum's Canal Festival Day. Operation is planned for the General portions of 75, 40 and 20 meter phone, and the Novice SSB subband of 10 meters. For a certificate, send QSL and SASE to *MOARC, Box 241, Verona NY 13478 USA.*

JUL 1

THORNHILL, ONTARIO, CANADA The Thornhill RAC will operate VC3D in conjunction with the City of Vaughan, Ontario, to celebrate Canada Day 1996. The station will be on the air during the RAC Canada Day Contest. To encourage the participation of other clubs, the Thornhill RAC will issue a certificate to acknowledge the contact during the contest. QSL cards will be available to all other contacts. For a club certificate or QSL card, send an SASE and your QSL card to *VE3YQY, c/o Gord Yazer, 24 Lindemann St., Thornhill Ont. L3T 5M8.*

JUL 12–14

PORTAGE DES SIOUX, MO The St. Charles County ARES will operate NØPNP from 0200Z Jul. 12th 1700Z Jul. 14th, as an ARES emergency exercise. Operation will be on phone near the top edge of the 80 meter–10 meter General class subbands, and near 28.350 MHz in the Novice class portion of the 10 meter voice subband. Local operation and Talk-in will be on the 145.49(-) ARES Rptr. For a QSL, send a letter-size SASE to *St. Charles County Emergency Management Agency, 301 Second St., St. Charles MO 63301.* The exercise will be operated from the shore of the Mississippi River, a brief history of the area will be included with the QSL on request.

JUL 20

BERGEN, NY The 1st annual Wire Antler Contest will be in two parts. (1) Build a 10m antenna using only wire and rope. Max. length not to exceed 140 ft. (2) The operating phase will be a Sprint-style operation 1900 GMT–2300 GMT on 10m SSB, from 28.300–28.500 MHz. Logs shall be postmarked no later than 31 Aug. 1996. Send packet inquiries to *Keith KE2DI [KE2DI@WB2VPH.#WNY.NY.USA.NOAM]* or *John KF2XC [KF2XC@WB2WXQ.#WNY.NY.USA.NOAM].* NOTE: No logs will be accepted via Packet!

Number 76 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad.

This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine,* Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the July 1996 classified ad section is June 12, 1996.

ASTRON power supply, brand-new w/warranty, RS20M $99, RS35M $145, RS50M $209. Call for other models, (818) 286-0118. BNB411

WANTED: Western Electric Audio Equipment. Amplifiers, pre-amps, tubes, speakers, parts, mixing boards, etc.: 1-800-251-5454. BNB1050

ALL ABOUT CRYSTAL SETS. Theory and construction of crystal set radios. $9.95 each, ppd USA. Send to: **ALLABOUT BOOKS**, Dept. S, P.O. Box 22366, San Diego CA 92192. BNB200

NOW ON 40 METERS! NEW, KNOB-TUNED w/DIGITAL DISPLAY, SYNTHESIZED QRP transceiver. Complete kit only $199.95, S&H $7.50 (continental US). GUARANTEED TO WORK. For info send SASE: Call/write to order: **S & S ENGINEERING**, 14102 Brown Road, Smithsburg MD 21783; (301) 416-0661. BNB334

NI-CD BATTERY analyzer cycler, PC controlled. DOS software. $289. P.O. Box 672, London, Ontario Canada N6A 4Y4. **Lamantia Products**, (519) 472-5566. Fax: (519) 472-1702. BNB385

HEATH COMPANY is selling photocopies of most Heathkit manuals. Only authorized source for copyright manuals. **Phone** (616) 925-5899, 8-4 ET. BNB964

IT'S BACK! The return of the HW-8 Handbook! Second printing. Modifications for the Heath QRP rigs. First class mail $11. DX add $4 for air mail shipping. **Mike Bryce WB8VGE,** 2225 Mayflower NW, Massillon OH 44647. BNB404

MAHLON LOOMIS, INVENTOR OF RADIO; by Thomas Appleby, (Copyright 1967). Second printing available from JOHAN K.V. SVANHOLM, N3RF. **SVANHOLM RESEARCH LABORATORIES**, P.O.Box 81, Washington DC 20044. Please send $25.00 donation with $5.00 for S&H. BNB420

R-390A SALES & SERVICE. INFO SASE **MILTRONIX** POB 80041 TOLEDO OH 43608. R-390 POWER INPUT CABLES $25.00, ANTENNA CONNECTORS $12.50, EXTERNAL AGC MOD $20.00 PPD. MON-FRI 9AM-6PM E.S.T. (419) 255-6220. BNB813A

WANTED: BUY AND SELL All types of Electron Tubes. Call (612) 429-9397, Fax (612) 429-0292. **C & N ELECTRONICS,** Harold Bramstedt, 6104 Egg Lake Road, Hugo MN 55038. BNB915

COMMODORE 64 HAM PROGRAMS- 8 disk sides over 200 Ham programs $16.95. 32 cent stamp gets unusual software catalog of Utilities, Game and British Disks. **HOME-SPUN SOFTWARE,** Box 1064-BB, Estero FL 33928. BNB1052

SUPERFAST MORSE CODE SUPEREASY. Subliminal cassette. $12. **LEARN MORSE CODE IN 1 HOUR.** Amazing super-easy technique, $12. Both $20. Moneyback guarantee. Free catalog: SASE. **Bahr-T3**, 150 Greenfield, Bloomingdale IL 60108. BNB1025

HAMCATION: 27 & 28 July 1996, Bahia Shrine Temple, Orlando FL. Table for Vendors, Individuals and Info. Booths. ARRL VE EXAMS. Further info. Contact **Cecil F. Morehouse** K4KEN, (407) 281-9169. BNB3001

MORSE CODE Computer Interfaces $49.95, with CW Filter $79.95, Free IBM Shareware and Ham Catalog. Dynamic Electronics, Box 896, Hartselle AL 35640, (205) 773-2758, FAX-773-7295, dei@whnt19.com. BNB1034

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More Test Equipment for the Microwave Workbench

Last month I covered frequency counters and recommended some basic microwave essentials for the test workbench. This month I will expand on that idea, covering some other handy gadgets that make microwave life on the workbench more enjoyable. I have also bundled together several technical tips, including one from the North Texas Microwave Group giving recommendations on how to test GaAsFETs with a VOM. In this application Kent WA5VJB describes how to test GaAsFETs to see if they're still alive, without destroying them.

Last month I discussed the use of a Gunn diode and attenuator (**Photo A**) to provide 10 GHz frequency drive for alignment and test generation. What about other frequencies? Is the Gunn diode arrangement still viable? Well, the answer can be "yes," but most likely it's "no." It still depends on what frequency you use and what you can find at an attractive price to pull the signal generation at your desired frequency. For 10 GHz operation the Gunn generator is fantastic; for lower frequencies something else is needed.

The oscillator

The oscillator you select for other frequency operation doesn't have to be anything as exotic as a frequency synthesizer. One of those would be nice, but anything from a crystal-controlled multiplier string to a free-running oscillator at the frequency of interest would function just fine. Be aware of your surroundings and try to adapt something that you can find locally for minimal cash outlay. As amateurs, we are known as good scroungers.

If you are lucky enough to have a wide-range sweep oscillator that tunes from 1 MHz to 18 GHz in one unit, you just might want to skip this message and go read the sports page. If you're still here, let's see what you can try to locate to pull this project together from whatever surplus is available locally. What would be very good to look for is some means of obtaining frequency agility so you can test several bands using one simple device.

> **"The most economical versatile oscillator available in easy-to-obtain material is the CATV or TV tuner front end."**

To my knowledge, the most economical versatile oscillator in easy-to-obtain material is the CATV or TV tuner front end. These can be picked up from your local TV repair shop or similar facility at little or no cost. They all contain a VCO in the several hundred to 1000 MHz or so frequency range, are inexpensive (notice I did not say cheap), and provide a hefty local oscillator signal output capable of injection directly into a mixer.

I might be over-pounding my drum on scrounging used or near-new TV/CATV components. But heck, it works and the parts are easily found in scrap or in the back of almost any agreeable TV repair shop for little or nothing. If you blow up (destroy the tuner) during conversion, go pick up several more. This is not a hard object to play with. Sure, it might take a little tinkering to figure out what lead provides what voltage and control but if they can be picked up for next to nothing, what's the gamble?

The tuner will be OK for frequencies up to 1 GHz. For testing on frequencies from 902 MHz and lower, it should be very suitable. For 1296 MHz and above, you will have to build other circuitry.

Typically, an MMIC (Microwave Miniature Integrated Circuit) type amplifier is driven hard into saturation to produce nonlinear operation. This causes the amplifier to be rich in harmonic output, due to operation in the non-linear region of its curve. Overdriving an MMIC amp input is the easiest way to cause this effect. The circuit for an overdriven MMIC is the same as a conventional MMIC amp circuit; it's just that you overdrive the circuit on its input. This scheme will give you good harmonic marker generation.

Another way to generate frequencies above 1 GHz (1000 MHz), like 1296, is to use mixed products of two generators. For example, connect the TV oscillator to a mixer with another lower frequency test generator and regenerate a signal that is a product of the two generators. I tried to generate 1296 by selecting a TV oscillator at 900 MHz and combining a bench signal generator (HP-608) tuned to 396 MHz, producing 1296 on the RF port of the mixer as one of the products. This scheme works well for frequencies in the 450 MHz to 1296 MHz range, where signal generation can be a little hard to locate.

The mixer requires the capability for operation at your RF frequency. For frequencies up to 2000 MHz a Mini Circuits SRA-11 can be used at powers of +10 dBm, with oscillator levels in the +7 dBm range. There are many different types of mixers suitable for this operation that could have coaxial type connectors mounted as part of the mixer assembly.

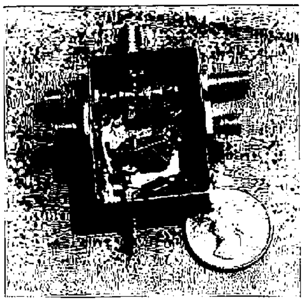

Photo B. Utility mixer for 10 GHz. The principles explained in the text can be applied to any other frequency by proper scaling of model. This circuit is actually a GaAsFET amplifier that is modified to be a mixer. See text for construction details.

The principles used in the signal generator circuit were tried many years ago when we were using WBFM simple receivers and did not have a good microwave signal generator to test them. What we did was take a microwave Gunn oscillator and use it as a local oscillator injected into the LO port of a microwave mixer. The IF port was similarly injected with a low frequency signal generator capable of operating from 10 MHz to 500 MHz. The RF port of the mixer carried the resulting products – that is, the Gunn frequency plus and minus the low frequency RF generator's frequency.

By setting the low frequency generator to, let's say, 200 MHz and adjusting the Gunn oscillator for a proper mix as detected on the receiver being tested, we were able to control the low frequency generator's frequency and level and make performance tests at 10 GHz. It's not highly calibrated in microvolt sensitivity but it does give some very meaningful evaluations of your system's performance.

Frequencies in the range of 3456 MHz and above require somewhat more complex circuitry. For 2304 operation our microwave group was lucky enough to have a supply of synthesizers, to use for local oscillator generation or test units. Normally, surplus oscillators for this range are scarce because there aren't many available. We seem

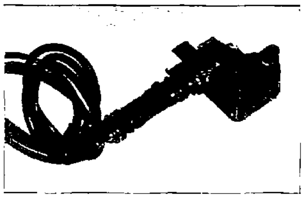

Photo A. A signal marker for 10 GHz use driven by a 2 meter HT. It produces a calibrated harmonic in the 10 GHz band for calibration purposes.

to be blessed in having two types to choose from: a Dielectric Resonator Oscillator (DRO) and a Voltage Controlled Oscillator (VCO). Both devices operate similarly, but the VCO is much more flexible than the DRO. The primary advantage to the VCO synthesizer is that it is more frequency-agile and has lower phase noise even after a multiplication of times four.

If you can't locate devices for the CATV tuner or the DRO or VCO synthesizers, I can supply any of these items for a minimal cost. The CATV tuners (new surplus) are $10 each postpaid or three for $20 postpaid. The DRO oscillators are $15 each, and the VCO synthesizers are $35 each postpaid for U. S. destinations. Both the DRO and VCO synthesizers require modifications before they can be put to practical work. If you are looking for a simple unit to experiment with, get the DRO unit. So much for oscillators.

The octopus mixer circuit

This octopus mixer is, in reality, an amplifier with added ports, allowing other frequency signals to be connected to and extracted from it. **Photo B** shows a beta test mixer. It might look a little strange with all the other coax connectors tied into the system. Basically, this unit is a 10 GHz amplifier of the single-stage variety and uses a single Mitsubishi MGF-1402 FET. Its design is straightforward: The amp input and output are isolated with 1 pF chip capacitors, and the FET is connected to input and output striplines. DC bias voltages are fed to this stripline via narrow-trace printed copper traces which act as RFCs to the 10 GHz signal. These traces (RFCs) carry the input negative bias and output DC voltage for operation of the amplifier.

"The octopus mixer is an amplifier with added ports, allowing other frequency signals to be connected to and extracted from it."

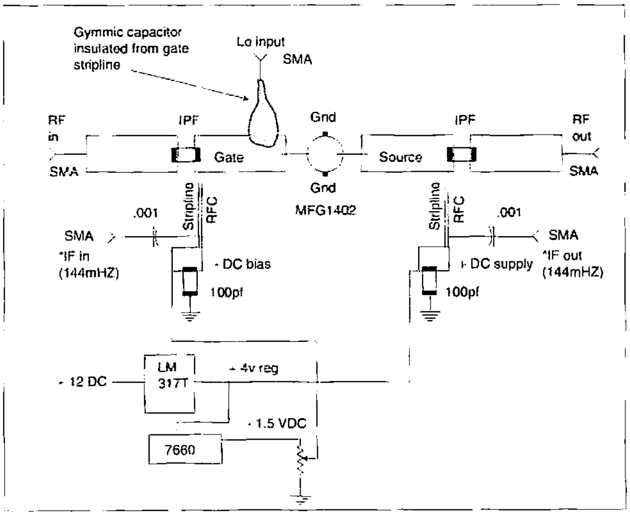

Fig. 1. Utility 10 GHz amplifier converted to a mixer configuration with additional input/output ports added. Concept is usable at other RF frequencies by adjusting size and component values, as shown in table.

RF In	IF In	IF Out	Lo In	RF Out
10.368 GHz	Ø	Ø	Ø	10.368 GHz
10.224 GHz	144 MHz	O	Ø	10.224 GHz
10.368 GHz	Ø	144 MHz	10.224 GHz	not used
Ø	144 MHz	Ø	10.224 GHz	10.368 GHz 10.080 GHz

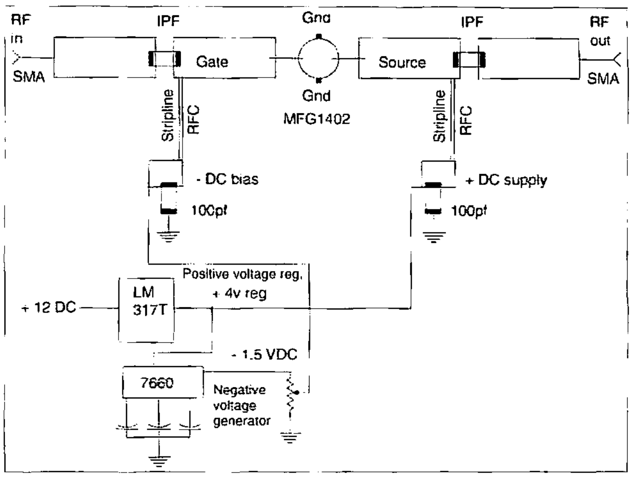

Fig. 2. Normalized schematic of basic amplifier circuit used for mixer construction as in ***Fig. 1.***

The circuitry below the FET amplifier is the positive and negative DC bias circuitry which allows the amplifier power supply to be self-contained and fed with only a single DC power input. See **Fig. 1** for the basic mixer amplifier circuitry, and **Fig. 2** for the normalized schematic of the 10 GHz amplifier before modification. The connections used in the modifications can be made applicable to any other frequency by proper scaling of the components/materials.

The mixer was equipped with many connectors to test the viability of using the amplifier as a bidirectional mixer; at the input side we could combine both an SHF and a VHF signal and have the product available on the normal output at SHF. Also, we could combine two SHF signals on the input to down-mix, setting the RF pickoff on the output to VHF by picking off RF from the RFC circuit. In this case, we would not use the normal RF output port.

Use good static prevention, namely a grounded work station. This could be anything as simple as a small chunk of copper PC board material to which everything is common grounded. That means you (wearing a static wrist strap), your low voltage soldering iron, and the amplifier to be modified. Everything is tied to the same sheet of copper, which is tied to a firm ground. (Please note: Your wrist strap contains a high resistance protection for your safety. You are not connected directly to ground. The high resistance provides a measure of protection in case the circuit accidentally connects to a foreign high voltage or AC. The wrist strap's purpose is to bleed off static charges, not pass power.)

The amplifier modification is carried out by first attaching extra connectors to the case so that you can connect input and output probes to the amplifier. If the amplifier you modify is lower in frequency it will be easier, as the size of the circuitry increases as frequency is lowered. Position the connectors in a similar fashion and experiment with the positioning of connections.

The marker generator

Another adjunct that can be very useful with microwave operation is a marker generator, which allows you to calibrate the operational frequency. This is especially useful if the equipment being used is simple wideband FM Gunn-type transceivers. These WBFM transceivers are not very stable, but they do provide an entry method into the microwave communications world for little expense.

The marker is nothing new and is not difficult to construct. It is made by obtaining a waveguide detector mount with a 1N23-type diode and driving this diode with RF power (100 mW) on a frequency of 146 MHz. The diode

rectifies and acts like a varactor, producing harmonics of the fundamental frequency. In this case, the driving power is a 2 meter HT on low power (FM) and the waveguide structure kind of supports the harmonics in the 10 GHz range. Now locating a frequency with an uncertainty of 146 MHz error is no problem at all. You don't have to worry about being off frequency by that much with simple equipment. This is not to say it couldn't happen, but it is unlikely.

Why use exactly 146 MHz for this test? Well, the 70th harmonic of 146 MHz is exactly 10220 MHz. This frequency is one of the main WBFM frequencies targeted for WBFM (Wide Band FM) operation. The other frequencies are 10250 and 10280 MHz. Notice that they are separated from each other by 30 MHz. This is due to the simple structure of the transceivers, which use each other's local oscillator to mix in the detector diode receiver and produce a 30 MHz offset of IF amplifier signal.

The harmonic calibrator can be improved greatly by replacing the 1N23-type diode with a varactor which is much more efficient in generating harmonics than the 1N23 detector. Don't forget to provide a ground return for the diode, using an attenuator between the transmitter and the diode. Most 2 meter transmitters have a 100 mW low power option switch, which in dB is +20 dB. All that is required is +10 dB, so a 5 to 10 dB pad (attenuator) needs to be connected coaxially between the antenna of the HT and the detector mount.

The RF sniffer circuit

The next handy item in the RF arsenal of tools on the bench is an RF sniffer circuit. It's basically a 50 ohm load sampled by a diode detector and tied to a sensitive meter. Use a meter amplifier for higher sensitivity. This can be nothing more than a terminated coax connector sampled by a diode detector then bypassed and fed to a low current microamp meter. If you connect a short antenna to the input connector it will serve as a (relative) field strength meter, and by making direct connection to the coax connector it will serve as a relative low power meter. This power meter can be used to tune up small oscillator strings or other RF low power output circuits, taking the place of commercial microwave power meters. The calibration and frequency response is always subject to construction differences and materials used. However, it can still be a good set of eyes up to 2 GHz or so for an indicator until you can actually calibrate it. Even if not calibrated, it will show you tuning adjustment indications.

You don't have to go through that exercise if you have a mixer available for your conversion. It is nice to know that there is some other method that can produce the same results, and even provide some extra gain in the process. Don't be embarrassed to try a new idea just because someone says it can't be done. If you haven't got anything to lose, give it a shot. You might come up with some new and enlightening idea. Be inventive; use the junk box and take a look at some of the circuitry that exists there—it can save you a lot of bucks.

As always, I will be glad to answer questions pertaining to this and other amateur-related topics. Please send an SASE or drop me a line on the Internet (clhough@aol.com). 73 Chuck WB6IGP

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Sweating the small stuff

If you've been working on radio, audio, video or computer gear at all for the last few years, you've undoubtedly noticed that your eyes were going bad and you were getting clumsier. Wait a minute, it isn't you; the circuitry is getting smaller and smaller, almost to the point of absurdity! Let's face it, we've all come to expect two-pound camcorders, CD players barely bigger than the discs they play, and high-powered Pentium and PowerMac computers we can plop into our briefcases.

Ham radio has gone the same way, especially in the walkie category. Just a few years ago, the ICOM IC-2AT was the standard 2 meter handheld. When it came out, the radio seemed a marvel of miniature engineering. Heck, you could hold it in one hand with no trouble at all. Many of these radios are still in use today, but they look positively huge, as do all the handhelds of that time. Even the Kenwood TH-21AT, the smallest HT of its day, doesn't look so darned small anymore. Our concept of small sure has changed! Although HF radios have until recently resisted the "small is beautiful" concept, they too are beginning to yield, with new 100-watt HF rigs no larger than the 2 meter mobiles of four or five years ago.

SMT/SMD

If you want to fit a dual-band HT with 50 memories, CTCSS encode/decode, digitally coded squelch, and all the rest of the goodies into a 2" x 3" x 1" box, you just can't wire it up on an old-fashioned, single-sided PC board, using regular parts and hand soldering. Nobody has hands that small or vision that good.

To get our gadgets to the size scale we have now, manufacturers had to invent a whole new way of making things. There were two keys to miniaturization: the integrated circuit, or IC, and SMT, or "surface-mount technology." The actual parts used in SMT are called, naturally enough, "surface-mount devices," or SMDs. Quite often, you'll see the terms SMT and SMD used interchangeably.

SMT made things smaller for several reasons. First, the parts didn't have wires sticking out, so they didn't need places on the components to mount them. Second, because they were mounted on the surfaces of PC boards, no holes had to be drilled through the boards, so designers could run other conductors behind the parts, either on the other side of the boards or *inside* them! Inside? Yup, I'm afraid so. Many of the mini wonders we so covet are made with triple- and even quadruple-layer boards. Of course, it's possible to make such boards for use with lead-mounted parts, but it's much harder, because the internal traces have to be routed around all those holes. With SMT, it's clear sailing all the way.

But how?

Although early surface-mount parts weren't much smaller than their lead-mounted predecessors, the parts quickly began to shrink. Even the larger ones were pretty hard to hand-mount, but today's "grain of salt" resistors can hardly be seen, let alone placed by hand.

Robotics provided the answer. A robot could operate with much greater precision than could a human, and it wouldn't get tired and start making mistakes, either! Pretty soon, robots were building most of the boards in our toys. In many cases, manufacturers consider these boards unrepairable; if it stops working, the board is replaced.

Can I fix it?

That leaves us hams in an odd predicament; we want tiny radios, but they're very hard to work on,

and fixing our own gear is supposed to be part of this technical hobby. Many hams are intimidated by SMT, and with good reason. Can you successfully repair or modify a radio made from SMDs? Yes, but I say that with some reservations. For many people, the size scale of modern radios is just too small. Let's take a look at working with surface-mount devices.

First of all, you'll need some new tools. You just can't tackle a microminiature radio with a 100-watt soldering gun! Even your trusty 30-watt pencil with its 3-millimeter tip is way too big. For SMD work, you need a 1 mm or smaller tip and about 15 watts of heat. Radio Shack™ has SMD tips for some of their guns, but you have to special-order them. Also, you need some very fine solder and narrow desoldering braid. Don't skimp and omit the braid; it's a crucial tool for this kind of work.

Even if you have good eyes, you will need some magnification to work at this size scale (besides, if you don't use a magnifier, you won't have good eyes for long). A head-mounted magnifier is extremely helpful. Also, get one of those little pocket-sized telescope/microscope combinations, if you can still find one. An alternative is a pocket microscope intended for the examination of phonograph styli (remember those?).

Very small screwdrivers are a must here. Trimpots and trimcaps are tiny now too, and you can't adjust them with normal-sized tools. A jeweler's screwdriver set is very useful.

"We want tiny radios, but they're very hard to work on, and fixing our gear is supposed to be part of this technical hobby."

Getting started

Although SMT boards are built with a special, low-temperature solder, you can use regular solder on them, as long as you're careful not to keep the iron on the board long enough to damage the traces. In keeping with the size of the parts, many conductors on these boards are ridiculously small, and they'll peel up if they get too hot, ruining the board. It's darned near impossible to fix it once that happens, especially if the board is multi-layered.

So, all soldering to a surface-mount board should be done very quickly and carefully. Of course, you don't want to make a cold connection, so you do have to keep some heat on the board for a few seconds. But, the old days of slathering on the solder until you have a big blob are over (not, of course, that anyone should ever have done that, but I've seen plenty of it). If you need to desolder, though, you may need your old 30-watt iron (but not the gun!). There's a great danger in trying to desolder without enough heat, in that you can pull traces up when you pull the braid away, because it gets soldered to them. The end result is just as bad as if you'd overheated them.

Although SMDs seem to take a surprising amount of heat without self-destructing, they are so small that the heat quickly makes it to the opposite connection, leaving you with a moving part when you didn't expect it. It can be mighty hard to get the part back where it was. A small screwdriver to hold it down can save the situation. If you get an SMD too hot for too long, the metal ends which provide the connections can dissolve, leaving you with a useless part. I've seen that happen more than once.

But what is it?

Now that we've looked at soldering SMDs, it might pay to know what it is we're soldering! Unlike good ol' "regular" parts, most SMDs have no markings on them; there just isn't room for any numbers. Some of the larger resistors have Japanese-style metric markings, like "103" for 10k ohms (that's a one, a zero and three more zeros), but don't be surprised to see tons (OK, milligrams) of unmarked parts. Here's a clue, though, as to how to identify at least some of them: The black ones are usually resistors, and the tan and green ones are capacitors. Polarized electrolytic caps are generally a bit bigger than resistors, and there will be a polarity marking on the parts. You may see some obvious resistors, with round bodies and color codes, but those are old parts; the latest stuff is all tiny, square and flat. Trimpots and trimcaps still look like they always did, only much smaller. Be careful turning them, because they can't handle much oomph. Transistors have two "leads" (stumps, really) on one side, and a third on the other. The single one is usually the collector.

Beyond these general guidelines, there really isn't that much different about SMDs. Some of the ICs, with their 64 or more leads, can be darned near impossible to change. It's rare, though, that you might need to do that. SMT is very reliable, with the most common problem being bad connections, particularly to the leads of ICs. I've seen many cold connections cause trouble. The hard part is soldering the leads without causing massive solder bridges, even if you were good at soldering standard components. If you must solder leads on one of those "millipede" ICs, try not to solder very close to the chip's plastic casing, because solder can get underneath, and it's mighty hard to remove it. If you do make some bridges (which I guarantee you will), use the desoldering braid across the entire bridge at once. Usually, that'll leave you with nice connections but no bridges. For that, you may need to use your bigger iron (but not the gun!).

Not for beginners

If you're new to electronics work, I recommend you stay away from SMDs until you're more experienced with normal, leaded parts. Even for old hands, this new technology is presenting challenges, especially as the parts get smaller and smaller. I was pretty good with the earlier SMDs, but the new ones are starting to reach my limits. If they get any smaller, I doubt I'll be able to work on them.

'Til next time, 73 de KB1UM.

Number 83 on your Feedback card

UPDATES

Can't seem to get those ducks in a row...

In Sam Ulbing N4UAU's "Tiny Tic-Tac Tester" article, *73*, March 1996, regarding the component values for battery chart—all columns should have lined up: Alkaline cells numbers should have been placed directly below the numbers for NiCad cells. It seems we missed something in making that chart.

Translation bollix?

In the April "Carr's Corner," in the second column on page 60 the values 50W, 5,000W, and 600W appear. These W (watt) values should all be Ω (ohms). In the original manuscript, they were correct, but for some reason, the Ω symbols all metamorphosed into Ws. The "200 watts" in the paragraph that follows is correct.

Also in April's issue, we began "Debunking Some Myths about Antennas, Feedlines & SWR" on page 40 and promised to continue it on page 59. **Toon 2** in the bottom right hand corner of page 59 is the second part of that article which is again continued on page 81.

Also on page 59, the two columns of "A Simple One-Hour" that claims to have been continued from page 40 should not be there. It is actually the specter of an article published months ago.

Author's update

Here's a tip from Marty Gammel KAØNAN for those of you who are having trouble finding the 3/16" copper tubing described in April's "440 Super J-Pole" article, and also May's "220 Super J-Pole" article. Go to the electrical department of your local building supply and ask for some #6 solid copper ground wire. The diameter is quite close to 3/16", and it works well as a substitute. It also bends more easily. (Its price should be about the same as the tubing.)

Coaxial Cable

Get comfortable with it.

George Wilson W1OLP
82 Fraiser Way
Marstons Mills 02648

Of the many different types of coaxial (coax) cable, only a few are used by the average radio amateur. These have 1/4" and 1/2" "nominal" diameters. The 1/4" types vary from 0.195" to 0.262" in diameter and require different adapters when used with UHF and BNC connectors. The popular 1/2" cables are 0.405" in diameter. A 1/10" (0.100") diameter type is also popular. It's used for filters and resonant lines, most often within project enclosures.

Both 1/4" and 1/2" types are available in nominal 50- and 72-ohm impedances. Half-inch cables can handle more power and have less RF loss than the 1/4" types. Coax cables handle power best when they are operating at a 1:1 VSWR.

The table at right contains some useful information on popular coax cables. Published data (in the handbooks) on coax line loss and power handling capability all assume that the cable is operating at 1:1 VSWR. Additional line loss, and less power handling capability, occur if the cable is not operating at or near 1:1 VSWR.

The dielectric in many coax cables is foamed polyethylene. These cables are lighter, more flexible and less expensive than solid dielectric types. Although they were often disparaged when first introduced, time has shown that most of the criticism was reactionary—people do not like changes. The ends of solid or foam cables should be sealed against moisture when used outdoors. Radio Shack™ 278-1645 sealant (tape) works well.

The Velocity Factor (VF) for the cables is shown in the table. This tells how much shorter a cable should be to be equivalent to the wavelength in air. This factor is of use when making filters (typically, stubs on coax lines to reduce unwanted signals), and when making stacking harnesses to operate more than one antenna from the same feedline. There are experimental methods of determining the exact VF of a particular line, but the published data is fine for most applications.

"Foam cables were disparaged when first introduced; time has shown that most of the criticism was reactionary."

Most ham rigs have 50-ohm input and output impedances, so it has become accepted practice to use this impedance between the various devices used in our ham shacks. In fact, since the VSWR and power loss are acceptable, 50-ohm cable is often used to feed resonant dipole antennas that have 72-ohm balanced (coax is unbalanced) impedance. Over the years, feeding balanced antennas with unbalanced coax lines has become normal practice. The 72/50 mismatch causes a VSWR of less than 1.5:1, with a short-run loss of less than 10% more than a matched line. This power loss is barely noticeable on a receiver's S-meter. A balun at the antenna may be used to help eliminate RF on the outside of the coax, consequent RF in the shack, and distortion of the antenna's radiation pattern.

50 Ohm Types*	Velocity Factor (%)	Outside Diameter (")	Dielectric Type (**)
RG8, 8A, 213	66	0.405	
RG8X	75	0.242	Foam
RG8 Foam	80	0.405	Foam
RG58, 58A, 58C	66	0.195	
RG58 Foam	80	0.195	Foam
72 Ohm Types**			
RG11, 11A	66	0.405	
RG11 Foam	80	0.405	Foam
RG59, 59B	66	0.262	
RG59 Foam	79	0.242	Foam

**Impedances shown are nominal*
***Dielectric type is solid polyethylene unless marked "foam," in which case it is foamed polyethylene.*

Pylon Mobile Mount

A quick way to install your car rig.

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

Recently, I decided to install a new radio in my vehicle, but didn't have any under-the-dash room (which you'll understand if you own a minivan like the Plymouth Voyager). There are, however, spaces between the front bucket seats, and between the seats and the dash, that are not used. Besides all that, I wanted a way to take the radio out of the vehicle and install it quickly; with only the antenna, power and ground connections to disconnect (or connect).

The requirements have been easily and inexpensively met by using a few lengths of PVC pipe, some Tee fittings, and some elbows. The design, which can be modified to suit your own needs, is one that I think you will adopt for your own installation. It took all of an hour to cut, fit, and glue the pieces together as shown. I used the 3/4-inch o.d. material, but you can use whatever is best for your requirements. The cost was well under $10 and, best of all, the standard mobile mount bracket that comes with a transceiver is easily and quickly attached to the PVC pylon. After all pieces are cut and fitted to satisfaction, each joint is cemented with PVC cement.

The length of the single support strut may be altered to meet the desired tilt-angle of the front parallel equipment support legs. The rectangular base can be designed with an appropriate size for your vehicle, and the length and width of the front support legs can be varied to suit...*before* you glue them together. To finish off my pylon, I bought a can of spray paint to match the plush interior color of my car (burgundy).

If you want or need a VSW8 bridge to go with your radio, there is plenty of spare room on this pylon for you to mount it. One of the MFJ-900 tuners is also mounted on my pylon with the radio, tuner, and VSW8 bridge, interconnected with short pieces of RG-58/U and appropriate connectors. Disconnect the ground, antenna, and power cords, and all the gear comes out with the mounting pylon. Try it. I think you'll like it.

You'll need: 6 90° elbows, 4 Tees, 1 48-inch length of 3/4 inch o.d. PVC pipe, small tube of PVC cement, and miscellaneous hardware as needed to attach the U-shaped metal radio mounting bracket to the pylon legs.

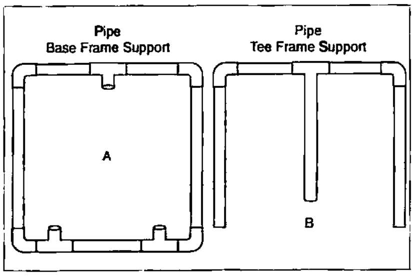

Fig. 1a. Pre-assembled frame: pipe base frame support.
Fig. 1b. Pre-assembled frame: pipe Tee frame support.

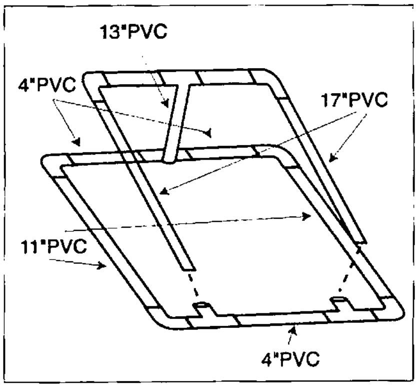

Fig. 2. Final assembled frame.

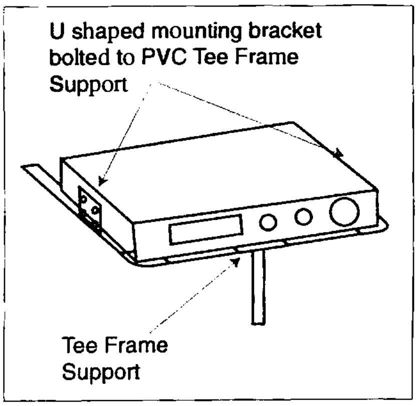

Fig. 3. Mounting radio to frame.

Number 86 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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Stevenson MD 21153

Allow me a few lines to mark the passing of nineteen years of RTTY Loop. We've covered a lot of territory in two decades; from simple shift-pot FSK circuits, up through early ASCII, and now into a variety of computer modes and digital communication, this facet of amateur radio called RTTY spans a wide spectrum. It has been, and continues to be, my pleasure to bring it to you through this window I call "RTTY Loop."

Speaking of longevity, I have a note from Tom Watson WAØDJP, who professes following the column for years, being a Lifetime Subscriber to *73*. Those of you new to the magazine might ask, "Lifetime Subscriber? How much did *that* cost?"

Well, back in those days, depending on which deal you got, it cost either half of $73, that is, $36.50, or $37, that is, *73* reversed. The certificates read "Our life or yours." Don't we wish we could get that deal again!

Joe Ross AA5BD, writes: "I have been reading your column for quite a while now and enjoy it. Question: I have an old RTTY T.U. unit, made by IRL, their model 500. I was curious if you are familiar with it, and if you think the program Autort would work with it, or maybe you might suggest something else. I had the unit working many years ago on an old VIC-20—man, you should have seen those characters fly by on the screen!

"My good friend KG5CB and I worked the ARRL RTTY Round-Up a couple of weeks ago from my Dad's lake house in Jacksonville, a small town in East Texas. We used a Kenwood 450 with the Carolina Windom Antenna from Radio Works up about 50 feet in an East Texas pine tree. We had 320 contacts; we used a PK232 and had a lot of fun.

"I don't know if you are familiar with the news group RTTY List but it is fun, free, and I see some great comments and reports there. To subscribe just E-mail to:wf1b-RTTY-REQUEST@ve7tcp.ampr.org

"Put SUBSCRIBE in the subject line."

Thanks, Joe, for all the information. AUTORT, which is on the first disk of the RTTY Loop Software Collection, should work fine with a "plain vanilla" terminal unit like the IRL-500. I ran one of them several years ago, and it was a clean, solid performer. There are many other programs around, though, which will run with a plain terminal unit and computer. Take a look at the full list of what I have on the RTTY Loop Home Page, at http://www2.ari.net/ajr/rtty/ or send a self-addressed stamped envelope to the post office box above for a printed listing.

The setup for the RTTY Round-Up sounds like a winner, a basic no-frills rig that shows how easy it is to get out on digital modes. As to the news group list, I am passing it along to the readership. For those on the Internet, who don't want to get bogged down in reading one message at a time, subscribing to a news group like this can allow you to keep a finger on the digital pulse without having to go to the doctor (sorry about that!).

I received a note from Brian Vanderheyden, KBØPRY, which asked about a BASIC program for Morse code. As he wrote at the time:

"I saw in a back issue of *73* (May 1992) a BASIC program for playing random Morse code on a PC. I have a new toy...an Epson PX-8 laptop from '84, that uses CP-M and has BASIC on it. I wanted to try out the basic program that was written by Elwood Downey (WBØOEW) on the laptop (I also have a IBM-PC clone, which I am using now). Anyway, before I type all that code out, I was wondering if this file is available, say, here on AOL? I have been thinking about writing something I could use on the PX-8 and this looks like it might fit the bill."

So, I sent him a copy (digitally, of course) of the column, and he replied:

"Thanks for sending the BASIC program I asked for, along with the other two. I ran the random Morse program from my PC and it worked fine. I have ported it to the Epson portable. There are a few differences in the BASIC command syntaxes that have to be adjusted for. I got it to run up to the opening statement for selecting the source and for the lines for adjusting speed and tone, before I get an illegal function. Looks like I will have to compare some BASIC reference books and rewrite part of the code. The other two programs look interesting. I had to edit them to get them to run under QBASIC in DOS 5.0. The first program will run, and I am about halfway through the second one. Mostly putting spaces in the lines of code, and substituting some PRINT@ strings to just PRINT. I have wanted to learn how to write in BASIC (and Visual BASIC for Windows) so this little exercise will help me learn."

Sounds good, Brian. You might upgrade from DOS 5.0, though, at least to version 6.x, as there are a few new features that are worth it. I would be interested to see what you come up with, eventually. In the meantime, I will add the May 1992 column to the library of columns on the RTTY Loop Home Page, so that others can play with the code, as well.

Interest in the RTTY Loop Home Page, by the way, has been growing daily. I have received some comments that hot links to downloadable programs may not be correct. Please understand that when I link to the programs the link is correct, but that many of these programs are on other servers, producing what is often termed a "virtual library." If the other server changes the address, the link on my board will be wrong. If this happens, PLEASE let me know about it. I will either fix the link, or disconnect the link from the other server. I am also very interested to hear what you, my readers, would like to see on the page. I have tried to put up things asked for, such as the Morse program mentioned above. Drop me a line, and let me hear your thoughts.

Next month, as we begin the twentieth year of RTTY Loop, I plan to respond to many inquiries with some basic, very basic, looks at how radioteletype is encoded, transmitted, and decoded. For many of you, this may be a review; for some of you, this may be a revelation. I hope, though, that for all of you, it is interesting. In the meantime, visit the RTTY Loop Home Page at the address given above, or drop me E-mail at ajr@ari.net, MarcWA3AJR@aol.com, or 75036.2501@compuserve.com, or spend 32 cents and snail mail me at the post office box above. See you next month! 73

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 East Chateau Circle
Payson AZ 85541

June is expected to provide reasonable, but not excellent, conditions for DX on the HF bands, and might provide some interesting 6 and 2 meter propagation between the 10th and 12th. Sporadic E propagation could also appear on the higher HF bands, especially around days marked "G" on the calendar.

The best days should be June 2-5, 16-19, 26 and 27, and 30. The poorest days are likely to be June 9-13 and 2-23, and the rest are expected to be fair or trending, as shown on the accompanying calendar.

Remember that thunderstorm QRN and high signal absorption due to excess daytime ionization in the Northern Hemisphere are expected during the summer months, resulting in fewer DX opportunities on the HF bands.

10-12 meters

This is a daylight-only band this month, but may present openings to tropical areas as well as short-skip openings on the best days (G). During intense, sporadic E conditions (rare this month) bursts of strong signals can come and go unexpectedly. Stay alert.

15-17 meters

These bands could stay open into early evening hours with possibilities of trans-equatorial DX on good (G) days and evenings. Signals seem to peak toward the west during afternoon and evening hours. Short skip to 1,000 miles or so should be available on many days.

20 meters

This should be your main choice for DX-chasing. Because some areas of the world are dark and others are in daylight at the same time, you can expect dawn-to-dusk, and even later. DX opportunities on good (G) days/nights. Short-skip will prevail to about 2,000 during the day, and farther at night.

30-40 meters

You may find these bands quite noisy (QRN) during the daytime, due to the onset of thunderstorms this month, but will be quieter during the nighttime hours. DX to your east will be the best before midnight, and best to your west before dawn. Choose good (G) days for best chances of scoring a new country. Short-skip of 100-1,000 miles during the day, and 500-2,000 miles or so at night will prevail.

80 meters

You may find that 80 meters will provide DX on good (G) nights, limited by thunderstorm activity. It may also provide short-skip openings of 200 miles or so during the day and 2,000 miles or more after dark.

160 meters

There will be *no* daytime openings here, due to a high absorption of signals, but it ought to provide skip to 1,000 miles or so after dark. Only rarely will you find DX, and only on good (G) nights with low or no thunderstorm activity. Low-frequency static bursts, hundreds of miles in length, limit your spring and summer operations.

Let me know how these forecasts are working for you. W1XU

JUNE 1996

SUN	MON	TUE	WED	THU	FRI	SAT
						1 F
2 F-G	3 G	4 G	5 G-F	6 F	7 F	8 F
9 F-P	10 P	11 P-VP	12 P	13 P-F	14 F	15 F-G
16 G	17 G	18 G	19 G-F	20 F	21 F-P	22 P
23 P-F	24 F	25 F	26 F-G	27 G-F	28 F	29 F
30 F-G						

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

Be alert for extremes of weather and geologic upsets on May 5 thru 7; also on May 19 and 20.

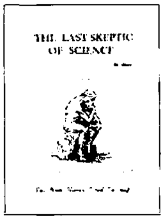
Where 10m is shown, also check 12m. Where 15m is shown, check 17m too. Where 20m is shown, be sure to look at 17 as well. Always check the bands above and below the indicated bands for possible openings to the areas shown. Remember that DX is where you find it, and not always where it is predicted to be.

Continued from page 64

MORE NEW PRODUCTS

NASA Mooned America!

René, self-published, 176p, 1994 $25 plus s/h (available from Radio Bookshop). Theme of this book is that NASA never put a man on the moon; that the whole Apollo saga was just a Hollywood-like production done with the help of the CIA. My reaction on opening the book was that this is totally ridiculous. Crazy. Impossible. By the end of the first chapter I was starting to wonder if I'd sucked in on a $40 billion NASA production. By the end of the book I was convinced that, as impossible as it seems, the whole world has been suckered. If you read this book and find any fault with any of the 30 "gotcha's" I want to hear from you. For instance, the moon's surface has no moisture whatever. So why do we see boot prints where the astronauts have walked? You've walked in dry dirt and sand. It takes moisture to hold a print. When I start listing problems, every scientist I've talked to has ordered a copy of the book. Since this is not available from bookstores, and the author is understandably shy, I've arranged for Radio Bookshop to handle the book.



The Last Skeptic of Science

René, self-published, 179p, 1995, $25 plus s/h (available from Radio Bookshop). I was so impressed with the author's grasp of science that I had to get his other book. In this one René makes a very good case for Newton, Einstein, Hubble and a bunch of other scientific idols being in error. He makes a very good case for the moon not causing the tides, for the earth not being a magnet, for there never having been any ice ages, for light not having a fixed velocity, for different masses falling at different velocities in a vacuum, for there being no gravity waves...for gravity being an electrostatic attraction, and so on. The worst part is that he does a first rate job of proving his claims. You can drive scientist bonkers with this book. Worse, his arguments are in line with what I've read in the Lerner, Hoyle, and Hancock books I've recommended you read. They even are consistent with my own theories of gravity and inertia. *Wayne* 73

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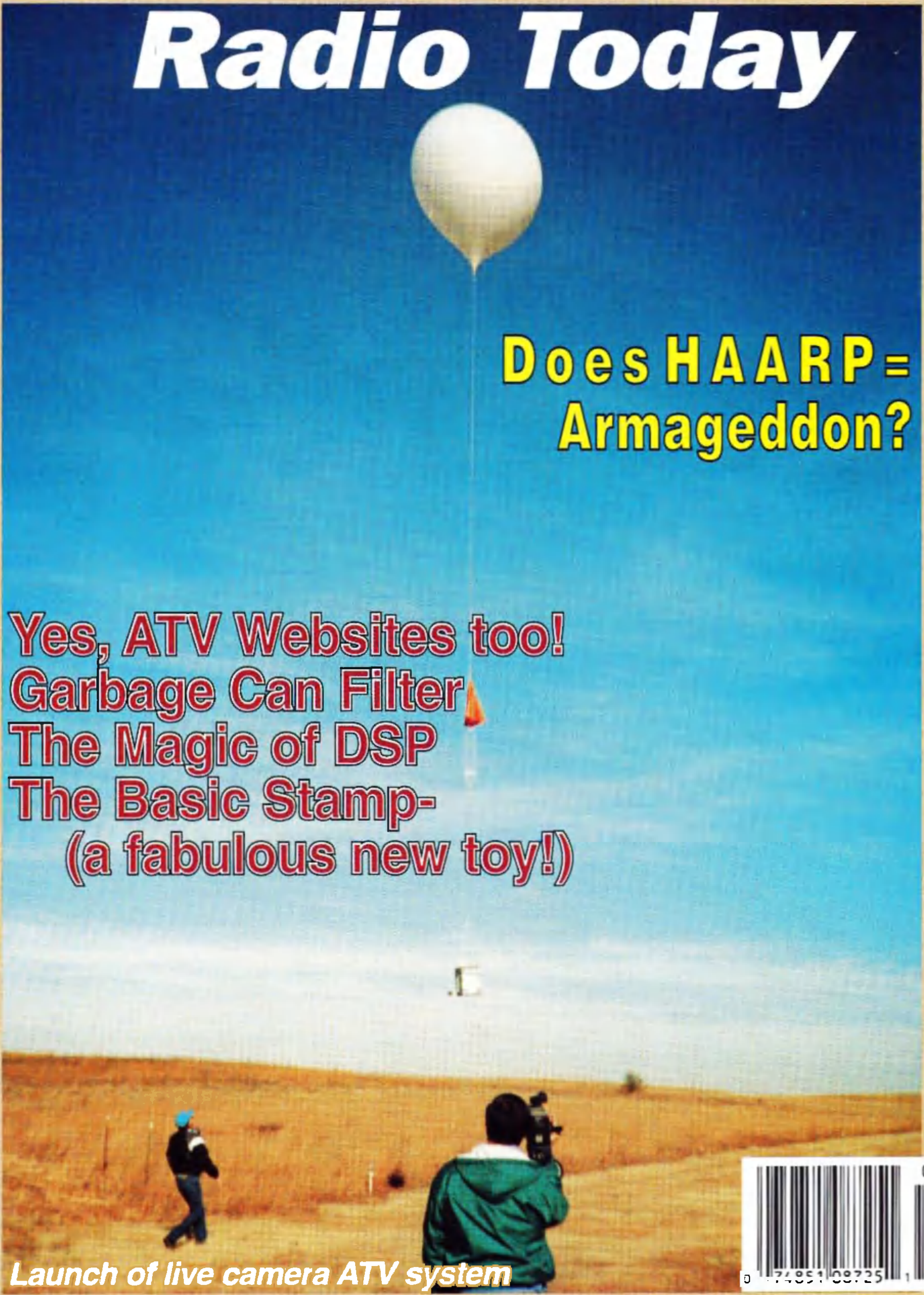

Does HAARP = Armageddon?

Yes, ATV Websites too!
Garbage Can Filter
The Magic of DSP
The Basic Stamp- (a fabulous new toy!)

Launch of live camera ATV system

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73® Amateur Radio Today

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ISSUE #430

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REVIEWS

DEPARTMENTS

HAM RADIO FUN SECTION

On the cover: Peter Sias WBØDRL of Salina, Kansas, launches a balloon that carried a live camera ATV system to cover over 100,000 feet. Photo taken by Bill Brown WB8ELK. We would also like to thank Bill for the picture of Wayne in this month's issue.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

ARRL Attacks FCC

Surely Wayne is exaggerating. Even the ARRL, which has pulled some corkers in the past, wouldn't be dumb enough to give the Big Kahuna a hot foot. Basically the League has the same complaint I've been expressing for many years: It's too bloody difficult to shut down hams who are causing trouble. There's a serious need for a shortcut to lifting the tickets of our more egregious offenders.

The result of all this is that the FCC has routinely been ignoring complaints from amateurs, no matter how well documented. And, of course, the bad guys know that they can get away with murder, even ignore fines, and nothing will happen.

So there's the League with a bunch of Official Observers who have zero clout. The League complained, "The League has had an Official Observer program in place, with dedicated volunteers, but its work product, once submitted, has been ignored and implicitly rejected by the Commission as a basis for any enforcement action, and the program is essentially non-functional as a result. The work of radio amateurs who volunteer thousands of hours monitoring these violations, conduct sophisticated direction-finding to identify the rule violators, and prepare transcripts for the FCC, has all gone for naught, and the volunteers are understandably and justifiably demoralized."

This lack of enforcement is well known and has contributed significantly to the growth of bad language, poor operating, creeping commercialism, malicious interference, and lawlessness on our bands.

The League is also on the FCC's case about interference to consumer electronic equipment such as TV, hi-fi, and so on. Consumers have every right to expect their TV sets to operate without getting interference from nearby transmitters. The manufacturers save a few pennies by leaving out the necessary filter. Oh, the FCC has told them tut tut, but it hasn't ever said dammit, put 'em in. The result is one heck of a mess, with consumers automatically blaming us for the interference. The FCC has the authority to fix the problem, but they've done nothing.

The question is, will the FCC see the error of its ways and reform? Or will it take aim at the messenger, shooting all of us down in the process? Well, that'll sure stop the complaints.

Yes, the League complaints are right. But I think they picked a really dumb way to tackle the problem. The FCC can be made to effect enormous changes if you go about it the right way. I was able to get the full cooperation of the FCC to make the biggest bunch of rule changes in history a little over 20 years ago, so I know it can be done, and how to do it. And it isn't by getting them mad at you.

Thanks K6YGK!

George Uminski K6YGK sent me a note with some stuff that might interest you. There was a column by Bob Pease from *Electronic Design* pointing out that people who use their minds a lot seem to be able to stave off memory loss and even Alzheimer's. Maybe I'm not completely wasting the time I spend compulsively doing crossword puzzles. He also passed along the address of Mead Killion, 61 Martin Lane, Elk Grove IL 60007, for anyone who thinks that hearing aids have to be lousy. He also included a review of *Reunions: Visionary Encounters with Departed Loved Ones*, by Dr. Raymond Moody. If I haven't reviewed this book for you yet, I should. I found it fascinating and convincing. It explains how anyone can set up a large mirror in a darkened room with only a 15W light and sit and talk with the "spirits" of those on the next astral plane. That's presuming there's anyone who's passed on that you'd like to talk with. Maybe 20m DX has more of an attraction than a parent or grandparent. I've been intending to find someplace around the house to set up a "psychomanteum" so I could thank whatever spirit keeps helping me at cribbage with "24" hands. And the angel who steps in to save me when people I've trusted take advantage of that trust.

More Ham Politics

When I got frantic calls from several of the repeater frequency coordinating groups asking if I would come to the ARRL-called coordinator's meeting in Missouri last October to help them deal with the ARRL, I begged off. I could see why the League called the meeting, but I didn't think that a fight on their turf, with them holding all the cards, was smart. Further, one of the League officials involved was a chap I'd trusted and then, I felt, had screwed me out of several thousand dollars a few years ago, so I thought that might interfere with my impartiality.

My advice to the coordinating groups attending the conference was to accept whatever benefits the ARRL was offering, but to form their own national coordinating council and cede no control. I suggested they look for a retired ham to run the council and cover his basic expenses with a small fee collected from each repeater they coordinate.

They were all adamant that they didn't want to turn coordination over to the ARRL, which was understandable.

I could understand, too, why the FCC would be enthusiastic about there being a Single Point of Contact (SPOC) for them to pass along repeater problems, thus saving them a ton of aggravation (and expense). I could also understand a certain reluctance of the ARRL, no matter their compulsive need to control every aspect of amateur radio so as to prevent any competing organizations from getting started, to put themselves into the position of being a deep-pockets target for lawsuits from every ham failing to get a coordination for his repeater. And we seem to be heading in the direction of there being one repeater for every licensed ham. Fine, we'll have 600,000 unused repeaters instead of a few hundred active and merely thousands of almost unused repeaters.

I probably shouldn't write about this at all, since every time I mention anything the ARRL is doing I get accused of being anti-ARRL. Go soak your head, if you think that. I'll be getting my 60-year plaque in a couple of years; how about you, buster? I joined in 1938. I would have joined a couple years earlier if W1CUN hadn't given me his 1936-37 *QST*s. Alas, when Cowan, the publisher of *CQ*, fired me as editor in 1960, he kept my 24-year collection of *QST*, my beloved SX-28A, my Navassa KC4AF DXpedition slides, and a bunch of other treasures. But since getting fired forced me to start *73*, that was a huge favor for me. That changed my life, making it possible for me to start *Byte*, *80 Micro*, *InCider*, etc.

I started building receivers and SWLing in 1936, graduating to bootlegging by 1937. Ask Walt WA6BMG about my early days on 160m in Brooklyn when he was W2LBF, just four short blocks from me.

Anyway, by forming a National Frequency Coordinating Council (NFCC), incorporating

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LETTERS

From the Ham Shack

Bill Haddad WD9HXH. Talk about pissing contests! I'd like to do just that to many of your letter writers. What's this crap about agreeing with you 95% of the time, then proceeding to make feeble attempts at refuting your statements? Also, some of your readers (AB6QR is a good example) have a habit of misconstruing what they have read. They miss the point completely, then ridicule and display their ignorance attempting to disprove plain ordinary facts. I have reference to my letter in the August 1994 issue and a really dumb rebuttal in your November 1994 issue.

Bill included a column by Charlie Reese lauding the Duesberg book, Inventing the AIDS Virus,*for which, thanks. I caught the same column in* Conservative Chronicles, *which has some great columns by Thomas Sowell, Paul Harvey, etc. The Duesberg book seems in agreement with Dr. Douglass in his marvelous* Second Opinion *newsletter on the AIDS deal. Well, whatever the truth, the Beck gadget seems to be helping to solve the problem, as are the Dr. Comby and some other approaches, much to the consternation of the AMA, FDA, NIH, WHO, and AIDS activists, all of whom have a bunch to lose if a simple cure is found. Money talks ... Wayne*

Jim Hynde KA8DDZ. Sheeesh! I can't help wondering if we are ever going to stop worrying about our hobby falling apart. Why are some folks so hung up over our hobby remaining on the leading edge of technology, and promoting it to thousands of new hams each year? I got into this hobby because I was interested in shortwave radio and communications, not because someone sold me on the hobby. I enjoy it and recently joined the Northern California QRP club. What a great club! No meetings, no minutes, no one asking me if I am going to help with the parade or some other event. A radio club that makes kits for the members to build. Doers! I have had a ball showing my QRP rigs to friends and generating a lot of interest in the hobby, by the way. Meet another member on the air and you have got yourself a QSO!

No, I do not have to sell my hobby to anyone. They are either interested or not. If no one else ever wants to learn CW or pass an electronics test to get a license that's OK with me. If the hobby must die, let it die gracefully. I fail to see how you can artificially keep a hobby alive by stuffing it down the throats of our youth. In the March issue of *73*, a reader wrote "Dynamic young (-minded) people need to join the stagnant clubs and get involved." Ha! What on earth makes you think they would want to join such a club? Let's see now, how could we pitch it? "Hey there young high school kid, I want to introduce you to a club of old white cholesterol-laden ham radio operators who have been in the hobby for 30 years and don't want to do anything. Wanna join up?" You must be joking. If we're not attractive to the youth of today then think about how you can change your club to make it attractive! Don't ask our youth to join to add "new blood," make the hobby appealing and they will come. Wish I had a nickel for every enthusiastic kid who got into radio but was turned off by the incessant babble on 2m. Two options: learn to talk like the rest of the goons or be an outsider. It's disgusting.

I laugh every time I hear about a club doing a presentation at a school and getting no interest. I bet those kids are saying, "Gee, if this hobby is so great and wonderful why are these guys here trying to sell it to us?" I do it by showing the QRP rigs I've built and showing how much fun it is to send Morse code on a telegraph key. I get much more attention with that than trying to show the "high-tech" aspect of the hobby. Try and convince someone on the Internet who communicates in the "chat mode" with friends in Europe to get involved in packet radio, heh heh. Or show my friends who carry cell phones how neat a 2m phone patch is, har har.

So, enough about staying on the leading edge of technology. Why not just have some fun on the air? Build a radio! The new ideas and technologies will be born from the spirit of radio. I may be wrong, but I can't imagine that the forefathers of our hobby became hams because they wanted to develop a new mode called SSB or FM. I think they just wanted to have fun.

Fun is the key, of course. Repeaters are fun, at least at first. Some people have fun doing the same thing every day for years, others need new adventures to maintain their interest. We offer both. I'm a "been-there, done-that" kind of person, so I need adventure to keep my excitement going. Thus I keep getting involved with new technologies. For the unadventurous we have repeaters and 75m nets. But recruiting is important if we're going to hold billions of dollars worth of public property for our exclusive use. Congress isn't spending much of the taxpayers' money on maintaining horse trails. If we don't provide some sort of public service, we're goners, and all those wonderful excuses we had for the amateur "service" back 50 years ago have just about dried up and blown away. Like just about everything else, we're in a "grow or die" situation, so I suggest we sell QRP, DXing, satellites, packet, and so on. And sell hard ... Wayne

Paul W. Minor AAØXG. Sometimes it seems like all you get from the media is news about crime and evildoers. But there is a large group of people in this world who are quietly active in making the world a better place. These people become known only to the extent that they can do their function, otherwise they want to stay in the background, but let's resist that.

"Elmer" is an old term used in amateur radio to describe a person who helps new amateurs to get licensed and off to a good start in the hobby. We need to encourage and recognize these great people, so I propose we establish an "Elmer of the Year" award.

I have a candidate to propose for this award and hope that others will submit Elmers they have known so we can give them the recognition that they deserve.

My candidate is Ace Hudson AAØVM. He is a good example of what makes ham radio and the people in it fun. Ace is a real ham radio salesman. He talks to just about everybody he comes in contact with about it in barbershops, restaurants, stores—anyplace he can bring up the subject.

Ace has a regular parade of people coming to his house with old radios or questions about tests, antennas, etc., and they usually leave with study guides, handbooks, repaired equipment, and well fed. He keeps a library of study guides, code tapes and reference books to loan. Sadly, many of these loaners are not returned, so Ace replaces what he can with his limited income.

Ace is neurologically handicapped as a result of an auto accident and has a small disability income. Nevertheless, he has gotten his Extra Class license and is a volunteer examiner in charge of the local radio club's monthly exams.

Everybody in our club looks forward to Field Day, where Ace cooks a wonderful variety of gourmet foods for us. People like this enrich our hobby and make it what it is. Let's hear from others out there about their Elmers.

If someone will design a nice certificate, we can have an Elmer of the Month ... Wayne

Michael Farrar VE3WMF. You and many others complain that No-Code Techs do not "upgrade," but it is only upgrading in your terms. No-Code Techs see it differently. We see the CW requirement not as an upgrade, but as a backward step into yesterday with a bunch of old-timers who are forcing us to live with them in the past. You say that we can't win this by hassling the Techs. Ridicule won't work either. But you use the ultimate ham radio insult by referring to Techs as exCBers (most are not and those that are wanted to get out of that ugly

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NEVER SAY DIE

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it, and then keeping it poor, potential lawsuits can be avoided. The NFCC would be valuable as a resort for those unhappy over some coordinating practices. While most groups are honest and fair, there are a few whose scrupulousness could stand some investigation. Some people just can't handle power honestly.

The main benefit to the ARRL of providing assistance would be an inside track on repeater frequencies for their *Repeater Directory,* which might help the publication be more accurate and up-to-date.

Adventure I

In my talks at educational and science conferences I stress the importance of amateur radio as a hobby entry into the high-tech world. I point out that ham radio offers plenty of adventure, as well as a sugar-coated learning experience.

When the Mohawk Amateur Radio Club newsletter published a list of famous radio amateurs (reprinted from *The Canadian Amateur*), naturally I couldn't help but go down the list and see how many I knew personally, or at least had met. And that got me to thinking about the adventure side of amateur radio, for it was through amateur radio that I got to know 20 of these famous hams.

Father Moran 9N1MM led the list. I first met him when I visited Nepal in 1966, where he put me up at his boys' school, and gave me a wonderful tour of the Katmandu area. We kept in touch after that. A few years ago, we met again in Singapore, and then again in Bangkok, where I gave a talk at the Seanet conference.

Next on the list was His Majesty King Hussein JY1, whom I visited and spent two weeks operating JY1 from the Royal Palace. Talk about an adventure! I had dinner with him and his family, and helped introduce amateur radio into Jordanian schools.

Then came Jean Shepherd K2ORS, the famous talk show humorist and later writer and film writer. Jean and I were good friends. I even taught him to water-ski on Jamaica Bay with my Chris Craft Express Cruiser.

I won't go down the whole list. That would expand this into another of my booklets. My trip around the world with Bill Leonard W2SKE could fill a hundred pages alone. My point is that all of these adventures came as a result of my interest in amateur radio, and I haven't done one single thing that any other ham couldn't have done. Or that any newcomer can't do.

It does mean my being adventurous rather than spending all my ham days making rubber-stamp contacts or checking in with the same small group every night for the rest of my life. Perhaps it's this same spirit that has triggered my entrepreneurial adventures.

My visit with Father Moran came about through my talking with Robbie 5Z4ERR in Nairobi many times on 20m. He talked me into coming over to visit. So I read a book on how to go on an African hunting safari for $690 by George Christian Herter and talked two other hams into going on the trip with me. Well, as long as I was going that far, I found that it didn't cost much more to keep on going around the world, so my safari stretched on to my visiting hams in around 23 more countries: Nepal, Burma, Ethiopia, Syria, Iraq, Iran (where I operated from the American Embassy), and so on.

Imagine the excitement of working your home station from Damascus (YK1AA), Nepal, Afghanistan (YA1NSD), and even on 75m from VK3ATN! Doing the kava ceremony with a village chief in a native hut on Fiji (VR2FD), zipping around American Samoa on a scooter, and flying all around New Caledonia with another ham in his plane.

Closer to home, I've had a ball mountaintopping on 2m from the highest mountains in Massachusetts, New Hampshire, and Vermont, working amazing distances from airplanes on 2m, and dawking a 10 GHz transceiver and dish to the top of Mt. Monadnock to work seven states on that band.

How about working moonbounce hams all around the world from the big dish at Arecibo?

If you haven't been having adventures in amateur radio, that's 100% your doing. Or, lack of doing. The adventure is there, just waiting for you. The opportunities are there at every turn, pounding away at the door. Take out your earplugs and have some fun that you'll never forget. I still talk about the 75m round table I tried to break into from Western Samoa (5W1AZ), but they said my signal wasn't strong enough so not to bother them. And my slow-scan operation from JY8AA and KC4DX (Navassa).

Have some adventure via amateur radio and then talk it up at your local schools. Get kids interested. Elmer. And I want to see some hint in the club newsletters that someone is making an effort to attract youngsters.

Also, newsletter editors, how about getting your fellow club members to write about their adventures in amateur radio? Thousands of hams have had wonderful adventures. Like when I went to Yugoslavia to help a fellow ham and his wife emigrate to America. Or when I "smuggled" hundreds of the latest transistors into Austria, Hungary, and some other European countries so the hams could build things. Or when I brought treasured American toilet paper to Bill Orr W6SAI, who was summering near Monaco on the Riviera.

There are plenty of fascinating and famous people to meet through the hobby, but you have to make an effort.

Now, what's the most exciting ham adventure you've had so far?

Adventure II

We have three main sales points when it comes to selling our hobby to youngsters. I do hope you aren't in disagreement with me about our needing to recruit youngsters. In the late 1940s and 1950s 80% of our new

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QRX . . .

DXer of the Year Nominations

The New Orleans International DX Convention is soliciting nominations for the DXer of the year award, to be presented at the 1996 convention Aug. 30-31. The recipient last year was Vince Thompson K5VT. All nominations received will be confidential and will be given equal treatment by the review committee. Send a letter describing your candidate and your reasons for the nomination to Michael Mayer W5ZPA, 5836 Marcia Ave., New Orleans LA 70124; FAX 504-524-2129. From *The DX Bulletin*.

FCC Commissioner Quello Issues Statement on Band Allocation

Introduction

1. By this action, the Commission addresses the Petition for Reconsideration (Petition) of the Report and Order in this proceeding filed by Fred Daniel d/b/a Orion Telecom (Orion). Specifically, we affirm our allocation of the 219-220 MHz band to the Amateur Radio Service on a secondary basis. We also maintain our regulations concerning the notification distance between Automated Maritime Telecommunications Systems (AMTS) and amateur radio operations, the exclusion distance between AMTS and amateur operations, and the type of equipment permitted in this band. However, we are amending our amateur rules to reflect the frequency upon which the AMTS stations operate. Finally, we are also taking this opportunity to update and correct the Table of Frequency Allocations as a purely ministerial matter.

Background

2. The 216-218 MHz and 219-220 MHz frequency bands are currently allocated on a primary basis to the Maritime Mobile Service for AMTS. In the Report and Order, we allocated the 219-220 MHz band on a secondary basis to the Amateur Radio Service for the provision of point-to-point fixed digital message forwarding systems, including intercity packet backbone networks. We found that this allocation will serve the public interest by: 1) relieving congestion that exists in the 222-225 MHz band in certain geographic areas; 2) encouraging the development and implementation of regional and/or nationwide digital message forwarding system networks that can be used for emergency and national defense communications purposes; 3) facilitating connection of local packet nodes to form such regional and nationwide networks; and 4) providing spectrum for exploration of new technology related to these purposes.

Submitted by Klaus Spies from PACKET.

Spread Spectrum Comment

The Tucson Amateur Packet Radio Corporation ("TAPR") submits the following reply comments regarding the Petition for Rulemaking (the "Petition") filed by the American Radio Relay League ("ARRL"), which proposed certain changes in the rules governing spread spectrum operation in the Amateur Radio Service ("ARS").

I. Permitting more widespread spread spectrum operation in the ARS would serve the public interest.

A number of the comments recognized the benefits that could be provided by more widespread use of spread spectrum technologies in the ARS. In addition to those that would accrue to ARS operators, as described in the Petition, increased use of spread spectrum in the ARS would contribute to the overall development of spread spectrum communications and, as a result, would provide benefits indirectly to commercial users as well.

Expanded use of spread spectrum in the ARS also would further the Commission's objective of promoting efficient spectrum use. At the FCC's March 5, 1996 *en banc* hearing on spectrum policy, Paul Barens, the "father" of one of the technologies that forms the basis of the Internet, made the following statement:

"What do we see today if we tune a spectrum analyzer or a radio receiver across most of the scarce spectrum bands? Mostly nothing. Dead air. This strongly suggests that most of our limited spectrum space is not being fully utilized and is going to waste. Specifically, with digital technology, spectrum bands can be more efficiently packed without interfering with existing services."

By increasing the ability of ARS operators to use spread spectrum technologies, the Commission would enhance their ability to use digital technologies to enhance spectrum efficiency, as recommended in the above passage. In turn, the Commission also would make it possible for the ARS to better accommodate the many new users seeking to use ARS bands, which are already congested due to the widespread use of non-digital equipment.

Although spread spectrum is not a panacea, it offers the promise of increased spectrum efficiency, reduced interference, and improved communication performance without adversely affecting other spectrum users. As a result, the Commission's rules governing spread spectrum operation should be modified to enable these technologies to flourish within the amateur service community.

II. Expanded spread spectrum operations will not adversely affect other ARS operations.

Several repeater coordinating organizations, who are responsible for the coordination of repeater operations in their regional areas of activity, filed comments opposing the Petition. These entities generally alleged that adoption of ARRL's proposals would cause widespread interference to, and disruption of, existing operations.

The fears and concerns expressed in these comments defy the proven ability of properly designed and implemented spread spectrum systems to operate in harmony with other spectrum users, are based upon "worst-case" scenarios, and reflect a desire to maintain the status quo even at the cost of stifling new technologies and services. As a result, they should not be permitted to prevent the development of spread spectrum in the ARS.

First, as discussed by Robert Buaas, claims that spread spectrum operation will raise the noise floor ignore the fact that few real systems operate near it, and those that do would profit from applying spread spectrum technology.

Second, in the ten years since the Commission first allowed limited spread spectrum operation in the ARS, a great deal of work has been done to address concerns that more flexible spread spectrum operation would adversely affect other types of ARS operations. In particular, the 1991 Buaas spread spectrum STA has made it possible for experimenters to engage in widespread use of spread spectrum technologies in the amateur band allocations below 450 MHz. Notably, operation under the existing spread spectrum rules and experim entation under the spread spectrum STA have not generated substantiated claims of objectionable interference.

Finally, the successful operation of Part 15 spread spectrum systems provide substantial evidence of the ability of these devices to coexist with other users. Today, millions of spread spectrum devices operating under Section 15.247 of the Commission's rules are being used to support end-user solutions in areas such as cordless phones, location monitoring devices, and local and metropolitan-area networking. These devices have been deployed across the United States without any local coordination and without any licensing by the Commission. Yet despite this flexibility and extensive use, spread spectrum Part 15 devices have almost universally operated without causing objectionable interference to other Part 15 devices or to others operating in shared spectrum. This success story provides ample proof that when spread spectrum devices are properly designed, manufactured, and deployed, they can coexist successfully with many diverse applications and, in addition, can facilitate frequency reuse.

In light of this history of successful, non-interfering operation, the Commission should not permit unsubstantiated claims of potential interference to thwart the introduction and use of new spread spectrum technologies in the ARS.

III. Section 97.119(B)(5) of the rules should be deleted, as suggested by NCS.

TAPR supports the suggestion made by the Manager of the National Communications System ("NCS") to delete Part 97.119 (b)(5), which

deals with the requirement for CW identification. TAPR agrees that no currently available commercial equipment implements such a function, and that deletion of this requirement will act to speed the rapid adoption of this equipment into use in the ARS.

Conclusion:

TAPR congratulates the ARRL for its forward-looking proposal to liberalize the spread spectrum rules in the ARS. ARRL's proposal, if adopted, could provide a variety of benefits to both members of the amateur service community and to the wider public.

Proposals to modify the status quo often generate opposition by those who are adequately served by it. Like the turmoil that occurred in the ARS during the transition from AM to SSB, the growing use of spread spectrum in the service will not be without incidents of disagreement and misunderstanding. For this reason, TAPR intends to use its resources during the rule making process to educate the ARS community on the theory, application, and practice of spread spectrum technology.

Yet, while fear and opposition are understandable, they should not be permitted to stifle new developments. In light of spread spectrum's strong track record and proven benefits, unsubstantiated claims of potential interference should be discounted and the Commission should act promptly to issue a Notice of Proposed Rulemaking proposing to implement the changes sought by ARRL, modified as discussed in TAPR's earlier comments.

TAPR believes that a program of continuing education of the ARS community on the merits and benefits of spread spectrum technology coupled with a wider use and deployment of equipment by amateurs in various applications, will go a long way towards resolving the concerns of many of those who have filed in opposition. TAPR intends to use its resources to perform this function and service for the amateur radio community in much the same fashion that it helped start the packet radio revolution in the ARS during the mid-1980s.

Respectfully submitted, the Tucson Amateur Packet Radio Corporation.

Touring and Tuning

From December 1995 to February 1996, my wife and I toured the southwestern United States. Our RV has a little 50-watt ham rig with a whip antenna on the rear bumper. During that trip, I tuned each of the HF bands at various times of the day to see just what activity was there.

I was amazed at how much was going on as I tuned from 160-10 meters. In almost every band and in almost every check there were more QSOs on CW than any other mode. The second highest usage was SSB, then various forms of digital communication, and last was AM voice. In that, the 10 meter band was most times dead. I did not hear any FM stations and only a very few 160 meters stations.

Who uses the HF bands? I found a good cross-section of ham radio. Daytime operation during weekdays was mostly older operators—mostly men of 60 and over. However, in this group, I found a number of lady hams operating CW, and a few on voice modes.

About sundown, the bands make a shift to the younger working people who now have a chance to enjoy our fine hobby. As we went into early nighttime, more and more younger operators filled the bands on all modes. Higher bands faded out many nights and the "good" bands became more active. The CW bands became very crowded at night.

On many weekends, the bands were filled with contest operators, with the CW bands being most active (CW takes the prize for the most activity per kHz of space during a contest while late nights and early morning are the prime time for the DXers).

What do hams talk about? Those of my age talk about health problems, economic stress among the elderly, children, grandchildren, radio in the old days, and conditions of community and government. Younger hams talk about computers, new radio gear, their antennas, and operating power. The youth of our ham community are not frequently heard on the HF bands except is for the Novice-Technician CW band.

I found message nets on many of the HF bands. The CW nets pass messages rather quickly. This appears to be the result of experienced operators and many coded messages. Voice messages often have reception problems, with phonetics slowing down the process.

DX pileups try the patience of most operators and lead to ugly remarks by a few, bringing shame to our hobby. This was the case on 75 meters, and to a lesser extent on 40 and 20 meters. Clean speech and courtesy are generally found throughout the CW bands, with few exceptions.

I did not have equipment to copy the digital signals. They were a small portion of the stations heard at any point in time. A very few digital stations were heard out of the generally accepted band plan. Likewise some CW stations were found outside of the band plan. However, in each case these things were not a serious problem.

What conclusion did I draw? Thousands of hams are busy expanding our hobby and our technology. Just a few darken our colors. Let's all work to enjoy, extend, and cleanse our wonderful hobby...de "Old Huck" Huckabee AA5BU. (Lifted from *AARC/Over-* Austin Amateur Radio Clubs Bulletin.)

Badger State Hams Pitch In

The north-central Wisconsin village of Weyauwega got an early and most unwelcome wake-up call on March 4, 1996 when, at about 5:45 AM, a Wisconsin Central Ltd. freight train en route to Neenah from Stevens Point derailed on the north edge of the village. Thirty-four cars left the tracks, 14 or 15 of which were pressurized tank cars filled with liquid propane. Six of those cars began burning.

Emergency officials decided to take no chances; all 1,700+ residents were evacuated

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Number 10 on your Feedback card

Ham Shack Test Equipment

What you really need, based on the author's 47 years of experience.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30, c/o Defendini
Salinas PR 00751-0030

Every ham shack, no matter how simple and inexpensive, or complex and costly, needs a certain amount of test equipment. Measurements must be made from time to time. Additionally, sometimes signals and voltages need to be generated.

The average ham does not have an unlimited budget, so he or she cannot load up on commercial test gear, most of which is rather expensive. However, some commercial test equipment along with some simple home brew gear, in the proper mix, will be cost effective and make every necessary job possible and easy to accomplish.

Digital multimeter

The digital multimeter (DMM) is probably the most-used item of test equipment in the shack. Although a few are available in kit form, they do not have all the usual capabilities of a full-featured DMM, nor are they very easy to construct unless you have lots of experience in close soldering on printed circuit boards. Therefore, I recommend purchasing a commercial meter.

Although prices range from about $20 to several hundred dollars, it is possible to purchase a full-function DMM for about $60-$80. By "full-function" I mean that the meter has the ability to measure (full-scale) AC and DC volts from 200 mV to 750 or 1,000 V, and AC and DC current from 20 mA to 10 or, preferably, 20 amperes. Resistance should cover 200 ohms to 20 megohms or more. The DMM should measure capacitance from 2 nF (0.002 µF) to 100 µF or more. Transistor DC beta (h_{FE}) should also be included. Most full-function DMMs measure from 0 to 1,000.

Some DMMs costing less than $100 will also measure frequency, usually to 20 kHz, and some as high as a few hundred kHz or even 1 or 2 MHz. However, they usually require a relatively high signal level, and with the usual 3 1/2-digit readout it is impossible to pinpoint a frequency higher than 9.999 kHz.

A few DMMs in the under-$100 price range will also measure inductance. However, the lowest range is usually about 2 mH full scale. Hams usually need to measure much smaller inductances in the µH range, so this capability will be of limited, if any, value to most, especially if this feature increases the price of the meter.

Almost all DMMs have a switch position for continuity, with an audible "beep" indication. Personally, I use the lowest ohms scale and glance at the readout.

All DMMs include a switch position to check diodes. Some work; some don't. Those that do work provide merely a go/no go indication. They will differentiate between open and short diodes, and functioning ones, but will not provide any indication of forward and reverse resistance, important characteristics of all diodes in many circuits. Attempting to measure diode resistances on the ohms ranges does not work. The voltage available at the test prods, usually less than 1 volt, is insufficient to bias the diode into conduction.

Analog multimeter (VOM)

A small pocket-sized analog multimeter which measures AC and DC volts, DC current, and ohms will be necessary when measuring forward and reverse resistance of diodes in order to match them. It will also be needed for monitoring voltage or current for a dip or a peak while adjusting other equipment, such as aligning or peaking tuned circuits in a receiver or transmitter, etc.

This type of meter does not have to have a high input impedance nor be particularly accurate-most such meters have an accuracy of only 2% or 3% of full scale. A multimeter with 1,000 or 2,000 ohms per volt sensitivity will be satisfactory. It will also be inexpensive. Buy one.

Dummy load

Although 50 ohm dummy loads for low power levels can be home-brewed using an appropriate number and values of 2 watt carbon composition or film (non-inductive) resistors (this is recommended if you operate only low power because it is cheap), many different manufacturers offer accurate non-inductive dummy loads capable of handling different power levels up to the legal maximum and higher. Prices vary from about $30 (MFJ-260B, 50 watts for three minutes, 300 watts for 30 seconds) to much more expensive load resistors mounted in gallon paint buckets full of oil. Choose one which will handle the power you are using, or plan to use once you get that amplifier you have your eye on.

Cross-needle SWR power meter

An accurate cross-needle SWR power meter rated for your output power or somewhat higher, connected between your rig and antenna tuner, will enable tuning for maximum power output simultaneous with lowest SWR. These meters are available from MFJ, Daiwa and other sources, in various power and frequency ratings. Some cover just HF through 30 MHz, while other HF meters include coverage of the 6 meter band. Others are available for VHF and UHF. Prices start at about $40 (MFJ-860, 30 and 300 watt ranges, 160 through 6 meters) and increase from there.

You can also home-brew SWR and power meters for HF, though you must use two separate meters, or switch a single meter between forward and reflected power. There are some excellent designs in W1FB's *Design Notebook* and other publications. Also check the back issues of the various ham magazines.

Continued on page 82

Garbage In—*No* Garbage Out

Turn hardware store purchases into a cavity filter for satellite and 2m reception.

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Do you capture pictures from Automatic Picture Transmission (APT) weather satellites on 137 MHz? If so, you probably are plagued by aircraft interference. The APT satellite frequencies are uncomfortably close to the aviation band used by every airplane and airport in the world. I live right under the glide path of San Francisco International Airport and, to make matters worse, I run a high-gain receiver and a wideband GaAsFET preamp so that I can copy the satellites down near the horizon. I was a prime target for the endless flow of planes that passed over my house, resulting in innumerable glitched and noisy weather satellite images.

"I not only eliminated the interference from planes and the airport's tower, but I can now copy the WX satellites several degrees lower in the sky."

The bandpass cavity shown here was like pennies from heaven. Aircraft interference is gone, and I get noise-free pictures. But let me offer you some advice: Don't test the cavity like I did – in the middle of my home office where my computer and WX receiver are. The QRM from the XYL was far worse than that from the aircraft.

There is something fascinating about building an RF device from hardware store parts, especially a 20-gallon garbage can. Getting good results from such "garden" variety materials is very satisfying. By the way, you 2 meter types can effectively modify this cavity for use at 144-148 MHz by merely taking an inch off the center pipe.

Why you need a cavity

Many hams do not know that modern superhet receivers develop selectivity late in their circuitry. **Fig. 1** shows a simple block diagram of a typical modern receiver. The front end, including the RF amplifier, must be extremely broad. Its job is to span a broad range of frequencies. The 2 meter band, for example, is 4 MHz wide. The receiver's front end, by design, cannot exhibit high selectivity. Even receivers with helical resonator front ends are several MHz wide. Many of the commercially available receivers used by hams for the weather satellite band, like my Hamtronics R-138, are even broader.

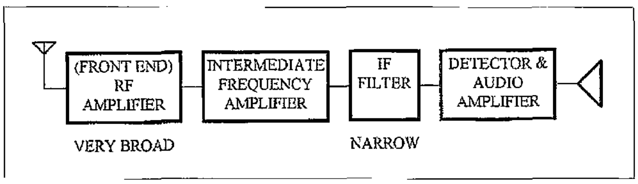

Fig. 1. Block diagram of a typical superheterodyne receiver. Selectivity is developed late in the circuit, in the IF filter. The earlier stages, especially the RF front end, are wide open to overload by strong adjacent signals and other noise.

A broad, unprotected front end like this can easily be overloaded (desensed) by signals several MHz off frequency. True, the IF filter in your receiver may stop you from hearing these signals, but such signals destroy the working sensitivity of your receiver whether you hear them or not. Even the normal noise in the passband of the front end of your receiver degrades the sensitivity. A receiver may show spectacular sensitivity when connected to a signal generator, but when it's connected to an antenna in a noisy environment, the working sensitivity of the receiver may be terrible. This is something many ham repeater owners often fail to consider.

By adding a passive filter ahead of your receiver and preamp, you will eliminate the aircraft interference the correct way and the effective sensitivity of your receiver will be greatly increased. I not only eliminated the interference from planes and the airport's tower, but I can now copy the WX satellites several degrees lower in the sky. Amazing, all of this from a garbage can, a piece of stovepipe, two connectors, and some 14 AWG wire!

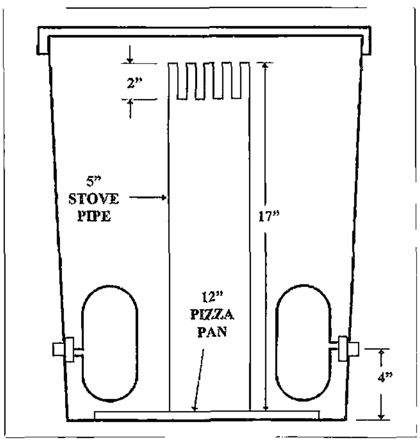

Fig. 2. Cross section of cavity, showing dimensions of inner conductor and placement of coupling loops.

Cavity basics

Like most of the cavities used in duplexers, this one is a 1/4-wavelength section of large diameter coaxial transmission line. It is open at one end and shorted at the other. The lid, as long as it is not too close to the open end, acts mostly as an RF-tight cover (see **Fig. 2**).

In designing any resonant cavity, theory specifies three things required for achieving efficiency: large volume, a 3.6:1 outer-to-inner conductor ratio, and low resistivity. Let's examine each briefly.

"There is something fascinating about building an RF device from hardware store parts, especially a 20-gallon garbage can."

Volume

Quite simply, the bigger the cavity, the better. Anything up to roughly 1/3 wavelength in diameter (21 inches at 137 MHz) will work. Above 1/3 wavelength, a cavity breaks into alternate modes of oscillation which have too much loss for filter service. Selectivity, the cavity's Q factor, improves in direct proportion to diameter. Since I was already constrained to make my cavity roughly 20 inches tall (1/4 wavelength on 137 MHz), when I visited my local hardware store in search of cylindrical metal containers with lids, metal garbage cans immediately caught my eye. They commonly come in two sizes: 20-gallon and 33-gallon. The smaller size is 17 inches in diameter and 22 inches tall. It was just what I needed, though the larger size would have worked well too.

Outer-to-inner ratio

A little-known fact about coaxial transmission line is that loss is minimum at a characteristic impedance of roughly 77 ohms. This is why we use 75-ohm cable where minimum signal loss is important, such as for TV receiver cables. We use 50-ohm cable for power applications because at 50 ohms impedance the cable will carry maximum power without breakdown.

The characteristic impedance of air line is determined mostly by the ratio of the diameter of the outer conductor to the inner conductor. For those of you who like mathematics, the formula for air-insulated coaxial line is:

$Z_0 = 138 \log(D_O/D_I)$

D_O = Diameter of outer conductor (the garbage can)

D_I = Diameter of inner conductor (both in the same units)

Since we want Z_0 to be 77Ω, we simply substitute in the above equation and find that D_O/D_I must equal 3.6.

In other words, the ratio between the garbage can diameter and the inner conductor needs to be 3.6:1 for low loss. Using a tape measure while still in the hardware store, I discovered that ordinary 5-inch galvanized sheet metal stove pipe is very close to the ideal size needed when used with a 17-inch diameter garbage can. Modest variations in this ratio are not critical, however.

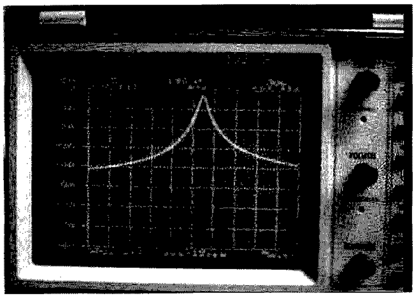

Photo A. Spectrum analyzer display of the filter's frequency response.

Low resistivity

The biggest source of loss in cavities is ohmic loss in the metal. It might not seem that something this large could have much resistance, but don't forget skin effect. RF current, even at low frequencies, flows in a thin film on the inner surface of a conductor, so even a large cavity can have significant ohmic losses. The galvanized surface of the garbage can is not a particularly good conductor. Aluminum or copper would be much better, but at this size and at 137 MHz the losses are modest. This is, after all, a receiving application where a few dBs are not critical. For transmitting purposes or duplexer use, you should go to the trouble of lining the inner surfaces of the cavity with copper or aluminum foil, particularly at the bottom and on the inner conductor.

The loops

Hams tend to consider cavity design a "black art," but it's not. Coupling loops seem especially mysterious, but are actually fairly straightforward. They simply need to be equal in size and shape, oriented perpendicular to the magnetic field, and placed near the shorted end of the cavity. The exact location, wire size and loop shape have very little effect on performance once they are optimized.

I simply kept changing the area of both loops, by altering the amount of wire or by bending the loops, until I obtained critical coupling. Critical coupling is the condition in which, as the loops get larger in area, losses have just begun to reach a minimum and selectivity is just beginning to fall off. This point is easy to find using a spectrum analyzer with a tracking signal generator (see **Photo A**). For this project, merely duplicate my dimensions and you'll be very close.

Construction

Dimensions and parts placement are shown in **Fig. 2**. Construct the center conductor by cutting a length of 5" stove pipe 18" in length (17" for 2 meters). At the bottom end, make axial cuts, 1" long and 1" apart, around the end to form bend tabs. Do the same at the top end, but make the tabs 2" long and 1/2" apart (see **Photo B**). At the bottom end, bend the tabs outward perpendicularly. At the top, break off every other tab, leaving the remaining ones straight. You will later bend these slightly to tune the cavity.

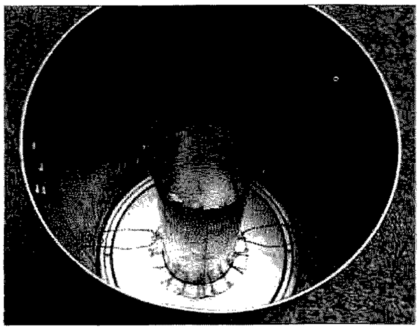

Photo B. Interior of completed filter showing center conductor soldered to pizza pan (in place) and coupling loops.

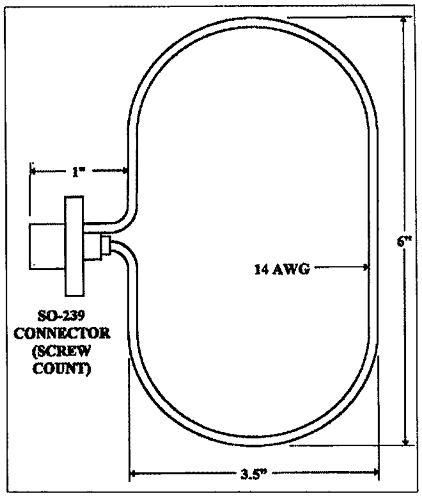

Fig. 3. Detail of coupling loops. Mount in the position shown.

Solder the bottom of the center conductor to the center of an inverted 12" common pizza pan (use a large, high wattage soldering iron). Use a pan that is not plastic-coated, or scrape off the plastic and tin the surface before soldering. Do not use excessive solder; it's required only for mechanical support. Capacity and skin effect make the necessary RF connection. Finally, secure the center conductor, on its pizza pan, into the bottom of the garbage can with a couple of screws.

Make the loops as shown in **Fig. 3** and **Photo C.** Attach the loop to its connector prior to installation. Install the connector and loop from the inside, rather than the outside. This makes the loops easier to remove. Use the kind of SO-239 connector that installs with four 4-40 screws, as opposed to the type that uses a large locking nut. Once the loops are installed, carefully bend the wire until both loops are the same shape and in the same position. The loops should be extended sideways so that they come within about 1/2" of the center conductor. Install them so that the end of the loop connected to the center pin is downward toward the bottom of the cavity. If you intend to install the cavity out of doors, be sure to seal the connectors from the weather. The lid need not be secured, but some wide plastic tape to hold it on would be a good idea.

Tuning the cavity

Be sure that the lid is on whenever you measure the resonant frequency. Without the lid, the resonant frequency will be quite a lot higher. The ideal test equipment to tune the filter is a spectrum analyzer with a tracking signal generator. With it you can display the shape of the bandpass curve, and set the coupling of the loops and the resonant frequency.

A less elegant way to tune the filter is with a dip oscillator. To do this, solder a small test loop of wire, roughly one inch in diameter, onto a PL-259 connector. Connect it to one connector on the cavity and connect a non-inductive 50-ohm terminating resistor on the other. You will then be able to "dip" the cavity at the small test loop.

Another possible method is to use an RF signal generator to inject a signal into one side and an oscilloscope on the other side of the cavity as a detector. Again, be sure that the cavity has a 50-ohm terminator installed on the output. The oscilloscope will have to be able to display a signal at 137 MHz.

If you lack the above equipment, you can also tune the cavity with just a signal generator and a receiver. Reduce the generator output until the received signal is near the quieting point of the receiver, and adjust the loops for best quieting. If you can't get your hands on a signal generator you can loosely couple some signal from a distant transmitter (yours or the satellite's) into the input of the cavity. Use a step attenuator

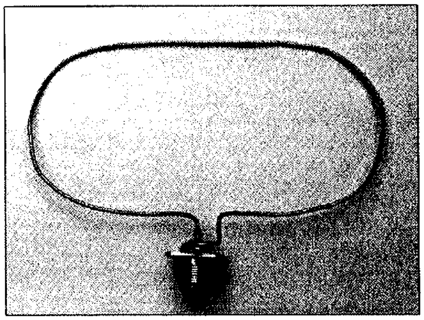

Photo C. Detail of a coupling loop.

on the output, and connect it to your receiver. Once again, adjust the attenuator to get the received signal down near the quieting point of the receiver, and make your adjustments.

Tuning is a simple matter. As you bend the tabs outward at the top end of the center conductor, the resonant frequency of the cavity will decrease. Effectively, you are adding capacitance. Such a cavity is electrically a parallel tuned circuit. Altering the capacitance in this way will not decrease the Q of the cavity to any degree. Q is determined almost entirely by cavity volume and metal resistivity. Tune the cavity for the center of the WX satellite band, or about 137.6 MHz. Changing the length of the inner conductor will also change the frequency. For 2 meters, for example, the center conductor will need to be roughly one inch shorter.

After building this cavity, I have to admit that it qualifies for an honored place in the long-standing ham practice of making do with very little. It also fits nicely into the grand ham tradition of tuna fish can, filing cabinet and lunch box radios. So if you are being plagued by pesky aviators or mountain-top intermod, give this project a try. You'll find it a winner, if you can get it by the XYL.

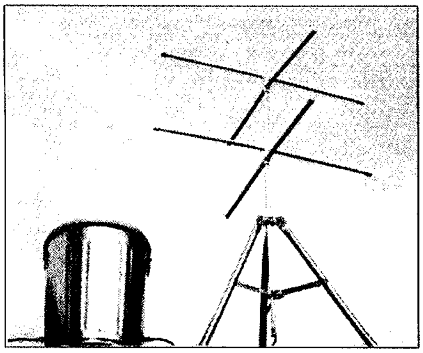

Photo D. Author's turnstile weather satellite antenna and cavity filter on the roof of his house.

A Funny Thing Happened On The Way To The Shack

Strange stories from the world of hamdom!

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Back in the days just after the FCC took 11 meters away from hams to create the Citizens Band, most of us still had equipment capable of operating on 11 meters. At that time I was living in a house on the top of a hill, an excellent location for transmitting. It seems there was this enterprising Citizens Band operator who would park his car right next to my house and spend several hours a day operating. There was nothing wrong with this, except he kept splattering all over my 10 meter receiver.

On several occasions I asked him politely to not park so close to my house, explaining that he was interfering with my 10 meter receiver. His response was that it was a free country and that this was a public street and I could investigate where the sun don't shine with my receiver. Well, I'm as patient as the next guy, but this was getting out of hand.

A little more information is necessary at this point in order to get the full import of what happened next. My equipment was Naval surplus out of an old battleship. You know the kind: solid silver coils, Faraday shields (also solid silver), etc., etc. It was built like the battleship it had come from, using the spare–no–expense government construction. When the Variac was cranked all the way up this baby could deliver a cool 5 kW without any strain.

And that's just what I did. I zero-beated his frequency, turned the Variac all the way up, pointed my three-element beam right at him and waited. As soon as he stopped talking and switched to receive I threw the switch and silently counted to five. Letting go of the switch, I walked to the window and looked out. What I saw was a large cloud of black smoke billowing out of his car. Some of you more technically inclined might be able to figure out just how many volts at what amperage I sent down his antenna. All I know is that it was enough. He never came back.

> ***"The priest, who was a ham, quickly realized that this was Morse code. The exorcism could best be performed by an electrician."***

There is a tale of a young ham back in the days when everybody operated AM. As the story goes, his neighbor, a middle–aged lady, filled her big old cast iron bath tub that had just had new copper pipes installed by her plumber. As she stepped into the tub, raising the water level just slightly, there suddenly came a voice speaking to her from the tub. Several Hail Marys later she once again she set foot into the tub and just as suddenly as before, a voice said unto her, "Five nine with QRM and a dipole."

Then there is this story about a lady who, on a dark, cold night, somewhere in the Midwest, dressed only in a robe and slippers, took the trash out. As you might expect, the door slammed closed behind her. She kept banging on the door and ringing the doorbell but it seems her husband, a ham operator, was in his shack with his earphones on, enjoying a DX with a ham Down Under, oblivious to all outside sounds. Finally, in desperation, she went next door and tried calling him on the phone. Same result. Luckily, the neighbor was also a ham operator, and was able to make contact with the station talking to the husband. Imagine his surprise when a voice with an Australian accent said, "I say, old chap, you'd better bloody well go down and let your wife in—it's bloody cold out there!"

Then there was the case of the haunted bedroom. It seems that several times a week, late at night, the lights in the upstairs spare bedroom would start to blink on and off, accompanied by a faint hissing sound. Thinking that there might be something wrong with the electrical system, the new home owner removed the fuse. When this didn't stop the light show, he called the previous owner for help. The previous owner told him that the blinking lights had been going on for as long as he could remember and that he didn't know what caused it either, but not to worry since it never hurt anybody.

Being somewhat less easygoing, the new owner decided to prevail on the local priest to come spend the night just to be certain the house was not haunted and in need of an exorcism. The priest, who was a ham, quickly realized that this was Morse code and recognized the call of a local ham. The next morning the priest explained that the exorcism could best be performed by an electrician—the length of the wiring in the bedroom was resonant on 20 meters.

Continued on page 20

Receiver Preamplifiers

The pros and cons of these little signal boosters.

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Preamplifiers and preselectors are popular antenna accessories, and are used ahead of receivers. If you use a separate receiver, or have one of those transceivers that permits a separate receive antenna, then you might be a candidate for a receiver preamplifier to improve performance. Chances are, however, that you're not such a good candidate. The preamplifier is one area where the actual performance is a bit counterintuitive. The "first blush" answer would seem to say that anything that boosts weak signals will help the reception of those signals, right? Nope! Not always.

"What do you mean, I've got mushy ghosts?"

The issue on receivers is the signal-to-noise ratio (SNR). If the signal level is above the noise level a certain amount, then you will receive it effortlessly. Some published sources say a signal must be 1 dB above the noise to be detected by ear, and 3 dB for reasonable copy by a skilled operator; effortless, comfortable copy is said to require about 10 dB SNR, which is how many rigs quote their own SNR.

The problem is that the preamplifier adds noise of its own, plus it amplifies the noise that's "out there" in the atmosphere. Thus, the preamplifier might impair performance, rather than boosting it. The correct solution is to buy a preamplifier that has a noise figure that's a lot better than the noise figure of the receiver front-end. A little bit of math called the Friis equation tells us that the major portion of the receiver's noise performance is set by the noise figure of the first amplifier in the chain. Thus, adding a noisy preamplifier ahead of a good receiver is dumb, but if the preamplifier is a lot better than the receiver, the overall performance is improved.

Maybe. There are other issues besides noise. You really don't want to have too much gain in a preamplifier ahead of a marginal receiver, or at all if the preamplifier is a little mushy. What does "mushy" mean? A proper preamplifier must have a high dynamic range, produce little intermodulation and have a high third order intercept specification. Otherwise, strong local signals in the same band with the desired weak signals may produce all manner of problems—like desensitization and ghost signals where none really exist.

Continued on page 20

Number 18 on your Feedback card

Weather Control and Mind Control

Science fiction? Well, it's science but not fiction!

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Payson AZ 85541

This saga began with Nicola Tesla, was developed by the Soviet Union and the United States (Star Wars technology), and has been used on and off since the 1960s for both defense and offense. HAARP is being further developed for operation in Alaska at gigawatt levels. Look out, world!

HAARP stands for "High-frequency Active Auroral Research Project" and is a project that uses megawatts of VHF/UHF energy focused along Earth's magnetic field lines by multiple arrays of phased, circularly-polarized antennas. The purpose? To "heat" the plasma contained in the Earth's ionosphere and magnetosphere by adding energy in the form of atomic particles (electrons) which then produce patches, areas, and even "shells" of enhanced plasma extending around the Earth at the heights of the ionosphere and magnetosphere. These are designed to:

- Disrupt radio communication.
- Disrupt electronic navigation and guidance systems.
- Destroy satellites, directly or indirectly.
- Destroy ICBM missiles and/or warheads.
- Control the weather.
- Provide a new means of communication.

This new technology creates extremely high-energy particles which can be guided along magnetic field lines to locations at various selected altitudes above the Earth. These areas of super-high energy can be made self-sustaining for specified periods of time, meaning that their effects upon the Earth (and us) can be designed and maintained at will...and within a few minutes of turning on the generators.

"Great areas of Earth can literally be 'frozen' or 'fried' at will by controlling the movement of air masses, particularly near the poles, where most of the Earth's weather originates in the form of high- or low-pressure air masses."

Frequencies and energy levels can be chosen to deplete specific areas of the atmosphere of nitrogen, oxygen, carbon dioxide, and other gases...or, conversely, enrich or enhance other areas with the same gases. Great areas of Earth can literally be "frozen" or "fried" at will by controlling the movement of air masses, particularly near the poles, where most of the Earth's weather originates in the form of high- or low-pressure air masses. These can be "artificially" moved and their pressure changed.

What about the "Woodpecker"? It was a Soviet system consisting of three plasma heaters: giant megawatt transmitters which were *not* over-the-horizon radar, as claimed by our government, although they could be used for that purpose. The main purpose, however, was for weather and mind control...yes, *mind* control.

The complex waveforms were generated, focused, and directionally guided by three Siberia-based transmitters to any point on Earth in a manner similar, but in reverse, to the way receiving antennas can locate the source of a received signal by triangulation. The transmitted signals are thus combined at the selected point by radio interferometry to produce various concentrated effects.

The frequency-agile Woodpecker signals were transmitted in the HF bands and exhibited waveforms containing unusual pulse and pulse combinations between about 10 and 20 Hz. Ten Hz pulses resonate at the approximate frequency of the space between the surface of the Earth and the ionosphere, producing what is known as Schumann resonance.

The human brain produces electrical waves whose frequencies are between about 0.5 and 25 Hz, and can be affected by concentrated pulse energy at these frequencies. These so-called Alpha, Beta, Delta, and Theta frequencies are each related to various "states" of consciousness. Therefore, interference with any or all of these frequencies by external means can effectively change human behavior.

Note 1. Alpha frequencies are about 7-13 Hz, Beta about 13-25 Hz, Delta about 0.5-3.5 Hz, and Theta about 3.5-7 Hz. The Alpha state is a relaxed and receptive state of consciousness where a question put to an individual in it may produce a response in the form of a

Theta burst in the Alpha wave known as the "K" or potassium spike.

Just suppose the Woodpecker actually interfered with brain waves in a single individual or a mass of individuals. energetic particles to "supercharge" the ionosphere and magnetosphere. In fact, Tesla predicted that someday artificial auroras would be produced to flood the world's cities with a soft illumination after dark. How else than by plasma stimulation and enhancement?

"Are there any radio amateurs out there who listened (one couldn't avoid it) to the Soviet 'Woodpecker' and experienced changed states of consciousness or aberrant behavior?"

What were the consequences? Are there any radio amateurs out there who listened (one couldn't avoid it) to the Woodpecker and experienced changed states of consciousness or aberrant behavior?

The required power level for effective alteration of plasma to create such effects is in the gigawatt range, but produceable by magneto-hydrodynamic devices using power fueled by natural gas, oil, or coal deposits and/or hydroelectric generators.

Alaska's natural resources of gas, coal, and oil are ideally suited for production of power of the magnitude required for plasma-heating transmitters. Of particular interest is the fact that great sources of natural gas and oil on Alaska's north slope are ideally located where polar magnetic field lines are concentrated. You may correctly assume the HAARP transmitters are located there.

The Earth can be considered somewhat like a bar magnet in which magnetic field lines originate at the ends and diverge at the center. Most of us remember science classes in which the teacher laid a paper or card on top of the magnet and sprinkled iron filings on the paper to make the field lines visible. The Earth's magnetic field lines of force originate at the poles and diverge over the equator. Launching electrons along these field lines is a simple exercise in electrotechnology.

Nicola Tesla developed his "magnifying transmitter" based on the Tesla coil and resonance effects to generate power (not just "signals") and transmit it wirelessly over substantial distances. He succeeded in doing so in Colorado before the turn of the 20th century. Tesla coil research and practice has been carried on ever since by numerous companies and countries. The military interest is, of course, power and control. "Magnifying" transmitters based on the Tesla principle are capable of producing

In the late 1950s and early 1960s, atomic and hydrogen bombs (euphemistically called "devices" by the military) were detonated in the ionosphere and magnetosphere to supply vast excesses of high-energy particles and create a radio "blackout" and disrupt radio communication. It worked! I happened to be on the air during one such test in 1958, and totally lost receiver signals for over an hour...on all bands. Everything "went dead" and I thought my receiver had died. Not so, as I later discovered when I talked to many hams who suffered a similar mysterious signal blackout at the same time. It was only years later that the truth was made public.

Satellites were also used to "seed" the ionosphere with radioactive particles and thereby enhance the plasma by alternate means. Another experiment sowed millions of tiny copper needles around the earth at an altitude of several hundred miles. It worked...but only marginally...as signals were temporarily intensified (not blacked out), but soon lapsed back to normal. Not everyone was enthralled with the idea of an artificial shell of copper encircling the earth.

HAARP transmitters ordinarily employ electrons whose masses are more easily raised to the point of cyclotron resonance, but particles of greater mass can be accelerated to produce "beams" of heavy-element ions, for example...and these can do great damage to distant objects (targets). We used to call them "atom smashers" in the old days, but technology has advanced as far beyond that simple phrase as electricity has advanced beyond fire.

Given the ability to raise the energy levels of plasma electrons and ions to sufficiently high levels, dispersion becomes a problem. That is, for maximum concentration of energy on a small area,

Given the ability to raise the energy levels of plasma electrons and ions to sufficiently high levels, dispersion becomes a problem. That is, for maximum concentration of energy on a small area, the particle "beam" must be very narrow. Lasers maintain collimation and in-step light waves more easily than devices that use heavier particles.

Ions of "heavy" elements (elements having greater atomic weight) are focused magnetically by cryogenically-cooled toroidal electromagnets placed along the beam path. A similar principle is used in your TV set, which deflects ions away from the electron beam and "traps" them to avoid destroying the screen of its cathode ray tube. A device that "shoots" and focuses electrons is called an electron gun, and a device that "shoots" ions is therefore an ion gun. The greater the atomic weight of a chosen "ammunition" element, the greater the power of the ion gun must be for particle acceleration, containment, and focus.

The Eastland patents

There are three basic patents relating to the production, use, and effects of enhanced plasma: U.S. Patent 4,686,605, issued August 11, 1987, to Bernard J. Eastland of Spring, Texas, and assigned to APTI, Inc. of Los Angeles, California, titled "Method and Apparatus for Altering a Region in the Earth's Atmosphere, Ionosphere, and/or Magnetosphere"; U.S. Patent 4,712,155, issued December 8, 1987, to the same inventor and to Simon Ramo, Beverly Hills, California, assigned to the same assignee, titled "Method and Apparatus for Creating an Artificial Electron Cyclotron Heating Region of Plasma"; and U.S. Patent 5,038,664, issued August 13, 1991, to (not available to this author), assigned to (also not available to this author), titled "Method for Producing a Shell of Relativistic Particles at an Altitude Above the Earth's Surface."

There are alleged to be at least 12 more related patents issued to Eastland et al. which describe in detail the "Treator," "MHD Generator," "Transmitter," and "Antennae," plus a wealth of ancillary devices, methods and uses. As in the three basic patents, all of the information contained in the earlier patents is incorporated in the later patents by reference.

Note 2. The following references are of particular interest: "Ionospheric Modification Theory," G. Maltz and F.W. Perkins; "The Platteville High Power Facility," Carrol et al.; "Arecibo Heating Experiments," W.E. Gordon and H.E. Carlson, Jr.; "Ionospheric Heating by Powerful Radio Waves," *Radio Science,* Vol. 9, No. 11, November 1974, pages 885-888, 889-894, 1041-1047, and 1049-1063, respectively. "The MST Radar at Poker Flat, Alaska," *Radio Science,* Vol. 15, No. 2, March-April 1980, pages 213-223. *Controlled Thermonuclear Reactions,* Glasstone and Lovberg, D. Van Nostrand Co., Inc., Princeton, NJ, 1960. *The Radiation Belt and Magnetosphere,* Hess, Blaisdell Publishing Company, 1968.

Note 3. Frequencies used by HAARP are 1.45 MHz, 1.8 MHz, and 7-20 MHz. "A Theoretical Study of Electron-Cyclotron Absorption in Elmo Bumpy Torus," Batchelor and Goldfinger, *Nuclear Fusion,* Vol. 20, No. 4 (1980), pages 403-418, describes one type of controlled nuclear fusion device in which heating is provided by microwaves at the electron-cyclotron resonance interaction.

Further information about HAARP and other fascinating subjects which may be of critical importance to our future may be obtained from the International Tesla Society, Inc., P.O. Box 5636, Colorado Springs, CO 80931; telephone (719) 475-0918; or FAX (719) 475-0582. Ask for their catalog of handbooks, guides, manuals, and summaries.

Much of the information for this article was taken from the *1995 HAARP Resource Guide,* available as #290004, and priced at $19.95 plus shipping and handling.

[A note from El Supremo: Can our beloved government really be planning to experiment on us on such a large scale? You can order Nick Begich's book, Angels Don't Play This Haarp, *from the Tesla Society book store (233p., ISBN 0-9648812-0-9, $15, 1995) and get the straight dope. More and more Alaskans are learning about this massive government project and there's a move in the Alaskan legislature to stop this nonsense before it gets operational. Well, exposés have shown us that they've done this sort of thing before with radiation and many drug tests on unsuspecting people. Meanwhile, the construction of this secret multi-billion dollar project is moving ahead in Alaska, with the whole world as guinea pigs... Wayne]*

A Funny Thing Happened On

Continued from page 16

And then there was the time I was "reading the mail," listening to a local station talking to KC4USN, the Naval Antarctic station. In the middle of his transmission he suddenly said, "Stand by, must QRT for a minute." When he came back on he apologized for the interruption, explaining that someone must have left a door ajar and he'd had to shoo out a penguin that had wandered into the shack. Life is too short for QRP (QRPenguin, that is).

These are just a few of the funny and unusual incidents involving ham radio that I have accumulated over the years. I'd be interested in hearing about other incidents you may have experienced or heard about. 73 Hal.

Receiver Preamplifiers

Continued from page 17

The ghost signals problem was driven home to me by a fellow who proudly boasted that he had two, count 'em—two, 20 dB preamplifiers ahead of his 2-meter band receiver. Oddly, he thought, there's a problem with the receiver because other hams' signals appear at two or three spots on the dial. No kidding. That receiver was experiencing front-end overload, and it's not necessarily clear whether the overload was in the receiver itself or one of the those preamplifiers. Disconnecting one of the preamplifiers gave him plenty of weak signal performance, but reduced the overload problem to negligible levels. Too much of a good thing isn't a good thing.

At the end of the day, if you want to improve your receiver's weak signal performance, put the first dollars into the antenna system (besides, it helps on transmitting as well). A good beam antenna is not too awfully costly at VHF/UHF frequencies, and some other forms (e.g. vertical collinear array) are positively cheap.

One thing that many people don't realize is that a lot of the wire array antennas found in textbooks (like my own *Practical Antenna Handbook* or *Receiving Antenna Handbook*—see Radio Bookshop) are practical at VHF/UHF even when they take too much space at HF frequencies.

Persistence Wins

Nothing ventured, etc.

King Waters KK5LU
4003 Grennoch
Houston TX 77025-2301

I took my test for Advanced the other day. It was a step far removed from my mind that day two years ago when I sat for Novice.

All this wasn't really my fault. I have wanted to be a ham since I was 11; radio fascinates me. I am told that at the age of three I disassembled an old black Philco AM broadcast receiver, while it was still plugged in. I must have done a good job; the repairman said he couldn't fix it.

But that was the tenor of my radio experience—fascination, interest, destruction. I learned Morse code as a Boy Scout, but radio theory was never a strong point. One of my best friends understood it backwards, but his interest was hi-fi, not ham.

"I was stunned. They had to tell me twice."

I would read up on the hobby occasionally. I bought ARRL books from Radio Shack™ right after I got married in 1972, but they were written by engineers, and I was a journalist. I still have the books. There are ads in the back for crystal-controlled ICOM 2 meter mobile rigs, and Heath kits, but my attention wandered.

Law school, a litigation practice, and four sons intervened. Then two things happened independently: I accidentally bought a copy of *73*, and I copied some CW. That's what started me off to that VE session the other day.

In 1992, I had a case involving a fatal accident on a microwave tower. The case centered on a claim of defective climbing belts. At a bookstore one day I saw a copy of *73*, and thought it might have some information on safety around towers. It did, although that's another story, but the important thing for me was that it also said there were study courses for licensing now, and that testing was by VEs, not the FCC. I thought I might look into it when I had the time.

Then I went flying that summer with a friend. We were navigating from Mobile to New Orleans when he asked me to tune in a directional beacon. The beacon would have a Morse identifier, he said, so the dots and dashes were printed on the air chart. I tuned to the frequency, but I recognized the code without the chart. He was surprised. So was I.

I went to Radio Shack and bought the Novice course. The code work went

Continued on page 25

Number 22 on your Feedback card

73 Review

JPS Communications NIR-12

DSP? Yes, you need it!

Pete Ferrand WB2QLL
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The endless struggle to hear signals with a minimum of noise has given rise to many little boxes with knobs over the years. However, I believe the best solution to date is digital signal processing (DSP). Let's face it, a computer can analyze a signal a lot better than a pair of diodes clipped across a speaker line. If that means nothing to you, it might be fun to take a nostalgic trip through the magazines and handbooks of 30 or more years ago to see just what our now old-timers were up against.

"Now you can have a 50 Hz bandwidth if you want it."

About five years ago I asked *73* if I could do a review of the JPS NIR-10. After using professional noise reduction gear, I was eager to see what a more reasonably priced ham version could do. The result was not only a positive review, but a unit that got used almost every day until last month, when I upgraded to the new NIR-12. The bottom line is that I'm now using the NIR-12 every day. This clever device gives me an array of weapons to fight interference in just about all modes: voice, CW, the digital modes, and TV.

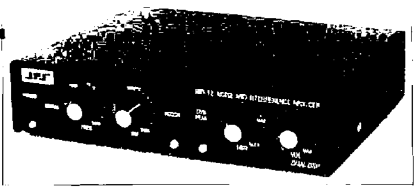

***Photo A.** The NIR-12 noise and interference reducer.*

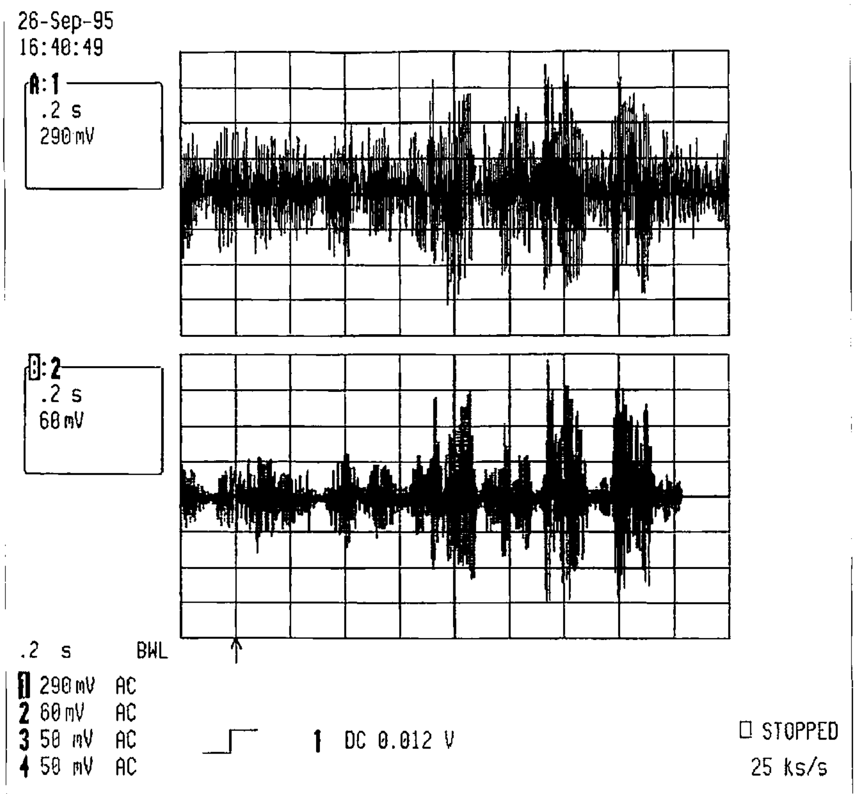

***Fig. 1.** The upper trace shows the unprocessed audio of a phone station in the noise. The lower trace shows the effect of the NIR-12, NIR mode only, NIR control set to 10 o'clock. The pattern displays amplitude on the vertical axis, time on the horizontal. The timing has been adjusting to compensate for the NIR-12's delay.*

Noise reduction systems

A DSP unit first digitizes the signal in a way similar to the process used to create sound from a computer or audio compact disc. The unit then analyzes the signal, tries to find what it's looking for, and subtracts the remainder. To the degree that the noise doesn't sound like what you're looking for, the NIR-12 can reduce it.

Any noise reduction device works best with a strong signal and little noise. Big deal, right? One good way to reduce receiver noise is to turn down the RF gain control, with either a knob or a front-end attenuator. I like to demonstrate this to any newcomers who, for some reason, have never learned to use those controls on a rig. As long as there is a reasonable difference between the signal level and the noise level this method is very effective.

The difference in noise reduction systems is most evident when there's about zero difference, or 0 dB, between the noise and the signal. It's also much harder for electronics (or our ears) to figure out the difference between noise and signal with something as complex as the relatively wideband human voice. It can do much better with a data mode, which is narrowband and usually synchronous (PACTOR, Clover, etc.), where the demodulator knows when to expect the signal and what it looks like, and can ignore what's left.

While we're waiting for some mode that digitizes our voices, we'll have to contend with pulling voices through an array of noise and interference. It's just getting worse with more electronics in our midst.

I work as a radio talk show host, and one of my major radio pursuits is listening to my competitors on other stations to make sure I'm being consistently original (yeah, right...). Living in a city and trying to listen to AM stations is about the toughest challenge for noise reduction.

The NIR-12 does the best job of any similar unit I've seen. It's also better in every respect than the previous JPS unit, the NIR-10.

One question that arises is why anyone would buy a DSP accessory when many transceivers now have them built in. The argument for the built-in unit is convenience and simplicity. Buying something like the JPS means you have the flexibility of using DSP with a variety of radios, especially mobile ones, or you can even clean up a noisy cassette tape. Then, when the technology is improved, you can get a newer DSP unit without having to upgrade your transceiver.

The NIR-12's features

Now, let's take a look at the NIR-12. It's built in a heavy steel box which provides magnetic shielding and keeps it from moving around when operated. The hookup is simple – you feed audio from the speaker output into the NIR-12's input, and connect the speaker to the NIR-12's output. It needs 11 to 16 volts DC, which you can get from the rig or wall transformer. Then all you do is adjust the receiver's volume control until the "signal" LED flashes on signal peaks, and control the speaker audio to your liking with the NIR-12's volume control.

You have four modes of operation, plus a pass-through mode where no noise reduction is performed. The modes are: NIR mode for spectral noise subtraction, dynamic peaking mode, bandwidth control, and a notch filter.

"The NIR–12 works well, and JPS's reliability and customer support are superb."

NIR mode

The NIR mode (for Noise and Interference Reducer) tries to recognize human speech and pass it, while reducing everything else. Most CW and data modes sound close enough to speech to pass as well. By adjusting the front panel NIR control, you can change the amount of noise reduction. This is the mode that works best on general electrical noise, static, and auto electrical system interference.

Five years ago I thought it would be helpful to put the noise reduction to a test, so I asked my friend John Seney WD1V, the area sales engineer for LeCroy, to come by with one of his fancy digital scopes to get a printout of what the difference is with and without the unit.

Well, now it's 1996, John's still my friend, and he's still selling for LeCroy, so once again he stopped by and took some scope printouts of 40 meters in the

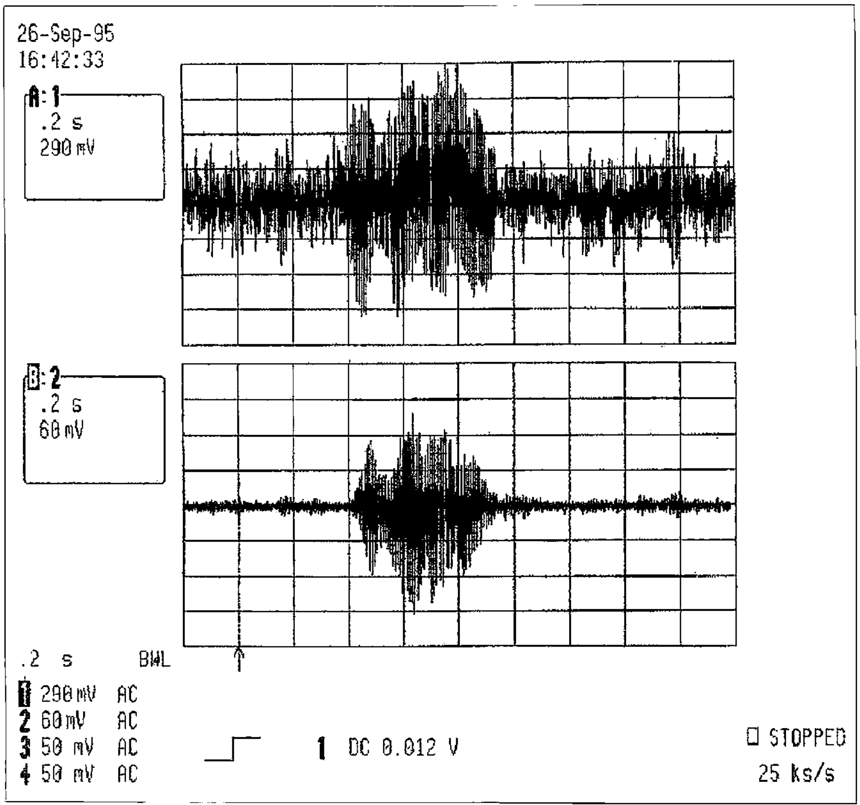

Fig. 2. The top trace shows unprocessed audio; the bottom one shows dynamic peaking mode. The data for the traces in both figures was captured at a sample rate of 25,000 samples per second. Each trace is two seconds long, so you're looking at 50,000 samples for each trace.

afternoon. I was using the same receiver, but yes, it's a much better scope!

The NIR mode graphs are shown in **Fig. 1**; the difference between the top and bottom traces is quite evident. I adjusted the NIR level for what sounded best to me, not the highest noise reduction, which JPS specifies as 0 dB.

The NIR-12 has an automatic mode that engages when the control is turned fully clockwise and provides a setting based on signal-to-noise ratio, and for some types of noise it's pretty close to optimum.

The problem with this subtractive type of noise elimination is that de-randomizing the noise leaves odd artifacts in the remaining signal. It seems much improved over the NIR-10, probably through an improved algorithm, or perhaps I've just become used to it. After all, I must have been used to listening to plain old radio noise, though I really can't remember that far back.

Dynamic peaking mode

The dynamic peaking mode looks for coherent information in the received audio, be it voice, CW, or data. It then forms a peaking filter around the coherent information. By "peaking" we're talking about a filter passing a bandwidth that's only as wide as the coherent signal. This mode is activated with a front panel push-button, and its aggressiveness is controlled with a three-position slide switch on the rear panel.

Dynamic peaking works best on general atmospheric noises. You lose just about all naturalness of voice, but sometimes it lets you copy an otherwise impossible signal. I'd have preferred that this mode be less aggressive. A knob for continuous control might have worked better than the three-position switch. Interfering voice signals are just as coherent as the one you want, so, by itself, dynamic peaking doesn't help, but you can use the bandpass controls to reduce nearby signals and the two work well together.

The artifact that dynamic peaking produces is, in JPS's terms, a "surging" quality which is hard to describe. I've discovered that by using an audio equalizer between the NIR-12 and the radio I'm able to improve the voice quality. A boost in the speech range of the voice being listened to can sometimes make the sound more palatable.

You won't see the artifacts, but you'll see the dramatic noise removal between the top and bottom traces in **Fig. 2**. As before, this is 40 meters at mid-afternoon.

Notch filter

The notch filter is much simpler to understand. It hears a tone and, if the "Notch" button is depressed, in five milliseconds 50 dB of the tone is eliminated. It will attenuate a whole bunch of tones, although there's less attenuation for more than four of them.

The notch mode is useful in getting rid of heterodynes, some data transmissions, noise from a nearby computer, and even people whistling to tune up. It isn't useful on CW or data modes, since it interprets those as tones as well. It's very impressive to visitors when they press a button and the tones just go away. This feature is very good about not removing any more of the audio than is necessary.

Bandwidth control

The audio bandpass filter provides a continuously variable passband of 50 to 3400 Hz. The center frequency of the filter can be varied from 200 to 3400 Hz. If you think for a moment, you'll see that this amounts to a low-pass filter with the center frequency at 200 Hz, and a high-pass filter if you set the center frequency at 3400 Hz.

As is typical of digital filters, the "skirts" are extremely steep; that refers to the graphical representation of bandwidth along a horizontal axis and amplitude along the vertical. It basically means that anything outside the bandwidth you have set is attenuated by more than 60 dB.

The most obvious use is with a receiver that has low quality filters, such as inexpensive shortwave portables. The other use is for modes that you don't have crystal filters for. Now you can have a 50 Hz bandwidth if you want it.

Most operators aren't aware that you can understand a voice signal with only a 1000 Hz bandwidth. That's because you can adjust the center frequency to anything you want, so you may find you

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Persistence Wins

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easily. My trouble was, and remains, theory. When I got to where I could copy 5 words a minute 100 percent, and my study program said I was consistently 85 percent accurate, I called around for test sites. Several were available, but I decided to go to the one in downtown Houston put on by the Echo Society.

The session started at 8:30 AM. I was there a few minutes early, nervous, like the rest of the 20 or so people in the room, a cold basement in the City of Houston's Emergency Operations Center.

The VEs called for Extra Class code takers. Three people stood up and walked out of the room, trooping upstairs to the test facility and the rest of us sat back. Gene Whitehurst WA5GZX looked at the group and said all of us should have gone upstairs to take the 20 wpm test. It wouldn't cost any more, it would be good practice, and so what if you didn't pass it—what if you *did*?

I was not persuaded, but when they called for the General code test, I decided what the heck and went along. There were seven of us. The test was in a long, narrow room, tables stretching its length, with cubicle desks along one side. The test was over a speaker—scratchy and loud.

I knew I could only copy 8 words a minute max. I knew it was a waste of time, and I knew the callsigns, being important, would be repeated at the end. When the tape started, I tried my best but it was hopeless. I thought I had the callsigns, but the rest was a hodge-podge. It looked like random practice, but the test was multiple choice and I found the first callsign on my sheet. Then I froze. The next callsign on my page was incomplete, since every answer listed had a virgule—the stroke sign—and two digits after it, showing mobile operation.

I checked both ends of the message but I had missed it both times. It was a toss-up, since two choices had different answers for the same callsign so I guessed and went on.

There was a question on weather. I saw a "C" on my page and a "Y" nearby. I guessed "cloudy" and went on.

The rig being used was the next question. I had a "Y" on the page and a neighboring "U" so I guessed "Yaesu" and moved on.

In all, I made such "informed" guesses on five questions. You need seven right. I guessed on five others. On one, I might have actually remembered hearing the answer without writing down the characters, but who knows? I turned in the answer sheet and my note paper. I grinned when the VEs said they would check to see if there was one minute perfect copy. I hadn't made 20 seconds.

I went downstairs as they graded. It would be a few minutes before they set up the Novice test, one I could at least copy. The VE was using 2 meters simplex to talk room to room. They called down to say only two had passed the General code test. One of them was me.

I was stunned. They had to tell me twice—I didn't believe them. The odds were all wrong. There were so many blanks on the page, although I do well at crossword puzzles. The remainder of the testees went upstairs to take the Novice test. I panicked, thinking I would miss this chance and they would regrade the General and flunk me. They didn't.

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73 Review

The MFJ 20 Meter SSB Rig

More fun in the sun.

Jeff Gold AC4HF
1751 Dry Creek Road
Cookesville TN 38501

I love to operate 20 meter QRP. I got my start in the QRP mode with one of the original MFJ 20m CW rigs and a dipole. I had a blast working all over the world while I was portable and using battery power.

When MFJ came out with the 20m SSB travel rig, I just had to have it so I bought one and had a great time. We used it during a University Club QRP/ expedition, an event which really gave students a reason to want to upgrade. They had a great time operating outdoors with wires strung in the trees during the weekend. The rig did tend to drift and had a loud relay, but these weren't serious problems. The newer MFJ units are much more stable and work first-rate. The club used the little rig on Field Day and in some big DX competitions with great success.

Unfortunately, I ran short a while back and sold my original MFJ 20, so when I recently came across the newer MFJ 20 meter SSB in a local flea market, I traded immediately.

It took me a couple of days to track down a CW adapter. I installed it, re-aligned the VFO, and set up all the little adjustments on the adapter board (pretty easy). It worked well, but there was no filtering so I found it hard to operate when there a crowd on the band.

I considered building a small audio filter and putting it in the cabinet with a selection switch on the back of the rig. Then I just happened to pass a Radio Shack™ and somehow my van just pulled right into the parking lot. I asked if they had any DSP units left. The young lady, who I had dealt with before, said they didn't; they'd all been sold. But, after some waving of arms, I got her to go look and she found one out back, still on clearance for $50.

I drilled a hole in the back of the MFJ for an audio signal out jack and spliced in the speaker. When I tried it, I smelled smoke. Oops, I had to insulate it from ground.

The Radio Shack DSP really works great with the MFJ. In the CW mode, it's like a whole new radio. There are three bandwidth settings; I have found the middle position best for most of my operating, and when there is a contest I use the narrower position. I hadn't really noticed a need for additional filtering while on SSB, but, since the filter was already attached, I started to experiment with the different DSP SSB options. The noise reduction feature seems to do a nice job and the narrower filtering sometimes comes in handy. The DSP now lives securely attached to the top of the MFJ. The whole thing, with my mini dipole and gel cell, is now ready for hiking trips.

> ***"This rig and accessories can easily be packed into a small airplane carry-on bag."***

The MFJ-9420 SSB travel radio

The manual says, "Your MFJ-9420 features a very potent speech processor. Please resist the natural temptation to shout or close-talk the microphone in order to be heard! Instead, hold the mike about two inches away and speak normally." On my first contact, looking at the small rig on top of a number of much larger rigs, I found myself with the microphone up close and talking louder than normal so that my small signal would become bigger. The ham on the other end said, "You're plenty strong, but it sounds like you are swallowing your mike. Back away and don't shout." When I did, he said, "Good quality audio and a nice signal." The transmitter draws about 2.2 amps peak at 13.8 volts. The rig I tested put out 12 watts on audio peaks. The rig will tolerate VSWRs up to 3:1.

Photo A. AC4HF's portable setup, using the MFJ-9420 and a Radio Shack DSP unit. (Photo by AC4HF.)

The VFO has a 8:1 reduction-drive with ball bearings so I had no problem tuning in stations, even under crowded conditions. There's a lighted analog meter which acts as an S-meter on receive. I checked it against my commercial rig and found the readings to be comparable. In the transmit position the meter monitors the processor. It is a good idea to keep an eye on this until you get used to the rig and you'll get the same glowing audio reports I get. There's a push-button on/off switch; a push-button tune switch; which is useful with an antenna tuner; and both power and transmit lights as well as a volume control. The mike jack is a five-pin DIN for connection with a dynamic microphone. The jack accepts a standard Radio Shack 274-003 plug.

The rear panel has a standard SO-239 antenna connector. The power jack is a 5.5mm OD, 2.1 mm ID which accepts standard plugs that can be purchased at Radio Shack. There is also a mike gain adjustment. The manual explains that you may have to turn down the mike gain if you are operating under noisy conditions. There are two additional holes for the plug-in CW adapter. One of them is for the push-

button switch and the other for the key. This module wasn't available at the time I tested the rig, but I am looking forward to testing it. I like 20 meters a lot and having both CW and SSB capabilities in a small portable rig is a big plus to me.

The rig is the same size as their CW QRP rigs and operates easily off a gel cell. I've used a 4 Ah gel cell for a long period of time without any difficulty. If you are planning on operating from hotel rooms or other places where power is available, there is an optional AC portable power supply available. This rig and accessories can easily be packed into a small airplane carry-on bag. I'll be packing the rig, a small gel cell, battery charger, and a 20 meter dipole for a trip to Arizona this summer. Be listening for me.

I don't think I ever had as much fun testing a new piece of equipment as I did this rig. It doesn't have a lot of bells and whistles, such as memories, but this makes it the easiest-to-use SSB rig I have come across. My first contact was with Frank W6AIY. He reported that the audio was solid and very good quality. Mike KD1QR said, "I read about that rig and I'm more impressed now that I hear the audio."

I started to get excited about what the rig could do. I made up a cigarette-lighter power cable and stuck my 20 meter Ham Stick on the back of my convertible. I heard someone calling CQ, Lou KC2LL. He told me that the rig had great audio and a good solid signal and stated, "Can't believe how well you are doing with low power and a Ham Stick antenna."

Next was to see if anyone could hear me during the CQ WPX contest. Contests are a tough test for any rig, but I managed to make quite a few contacts using the home station five-band quad. At one point I heard a big pileup on TM1C. I gave him a call. We exchanged contest information and I snuck in the comment that I was working low power on a new MFJ rig. He came back and asked me if I really said I was using low power. When I affirmed that I was he said, "Unbelievable, you are stronger than the rest."

The transceiver was designed as a small, portable travel rig that is rugged enough to take on camping trips. The rig was not meant to be a replacement for your main station rig. It doesn't have RIT and there is no jack for headphones, but it does do a great job at what it was designed to do. It lists for $219.95 without the microphone and $229.95 with the mike—buy the mike. The AC portable power supply lists for $39.95.

The Radio Shack DSP noise reduction system

The unit is very small and light. It can operate off a standard AC outlet if you purchase the optional adapter. It comes with a power cord to operate from 12V DC. The unit is a computer controlled digital signal processor with a built-in audio amplifier and speaker. It was designed for communication receivers and its purpose is to reduce heterodynes, to reduce background noise and separate it from the desired signal.

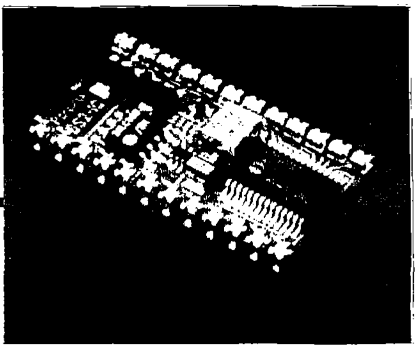
The audio amplifier puts out 5 watts, which is more than adequate. There is an external speaker jack that lets you connect a speaker using a 1/8" plug. There are filters for CW that allow you to select one of three bandwidths. In the SSB mode you can either choose the bandwidth mode (works same as CW) or the Noise Reduction Mode (NR). The NR mode really gets out the heterodynes well for such an inexpensive unit. It has an on/off control that also controls the volume, and a power-on indicator. It comes with a mobile mounting bracket which slips on the DSP end, and hardware is provided for the car installation end. A phone jack is also included on the front panel. It is a very simple and straightforward unit to connect (the cable to connect to the rig is included) and to operate. I didn't even have to read the manual.

Number 28 on your Feedback card

73 Review

The BASIC Stamp

Wait 'til you read about this fabulous new toy!



Bob Johansen WB2SRF
61 Burnside Ave.
Staten Island NY 10302

The adage "Good things come in small packages" needs to be changed to "Great things" for Parallax's BASIC Stamp. It's a stamp-sized computer that runs BASIC. How 'bout them apples?

Currently there are three versions of the BASIC Stamp: (1) The original version, now several years old, which used two socketed DIP-ICs mounted on a small (1-1/2" x 2-1/2") PCB. It has eight I/O ports, program storage of 80 BASIC instructions, and 4 MHz operation. A small prototyping area on the board is reserved for your use. (2) The surface-mount module version of the BASIC Stamp, which is called the BS1-IC, and has 14 pin (SIP) single in-line pins. The size is about 1-3/8" x 3/8" x 1/8" thick and it has the same electrical specifications as the original version. (3) The new BASIC Stamp II (BS2-IC), which is also a surface-mounted module, has 24 (DIP) dual in-line pins. This one is just slightly longer than a postage stamp. It is only about 3/16" thick and fits into a standard 0.6" wide DIP-IC socket. It has 16 I/O ports and program storage of 600 BASIC instructions. It includes many new functions and performs much faster with 20 MHz operation.

Note: The BS1-IC and the BASIC Stamp II modules require a separate carrier board to provide power and programming connections, while a small blank area of the board is reserved for your prototyping. It is wise to buy at least one carrier board for whichever version of the stamp you intend to use so that you can program it. Afterwards, you can place the BASIC Stamp module into a socket on your own PCB to work with your own projects.

These products have come to revolutionize the way your projects can be controlled, keeping your time spent on development to a minimum. For example, BASIC Stamps are being used by model railroaders to control their train layouts. Robotics hobbyists use them to make "brains" to control their pet robots. Ham operators use them to build ID units, repeater remote controllers, etc. There are also endless industrial applications for this device.

"Its real beauty is its ability to change time durations or circuit paths quickly and easily."

Any application which previously required devices such as the venerable Signetics NE555 timer, various logic gate ICs, etc., wired together to serve a function, can be better implemented by use of the BASIC Stamp. Its real beauty is its ability to change time durations or circuit paths quickly and easily—you just change a few keystrokes during programming, instead of having to bother with the selection of resistor or capacitor values and/or hacking away with hard-wired circuitry to obtain the desired function.

Once the desired program is developed, loaded and debugged in your system, you disconnect your PC from the Stamp and it will continue to function on its own. The program is held in EEPROM (electrically erasable programmable read only memory) so that no battery backup is required for it to hold your program (for over 10 years) and it can be reprogrammed hundreds of thousands of times for different functions. They are based on Microchip Inc.'s PIC 16C56 and 16C57 RISC (reduced instruction set) based microcontrollers to which Parallax has added its proprietary P-BASIC interpreter, permanently burned into the chip's memory.

How to get started

The BASIC Stamp is programmed by using a special programming package that sells for about $100, a one-time investment for programming many BASIC Stamps. The IC module and the matching carrier boards are sold separately, and are not included with the programming package. The BS2-IC with the carrier board sells for about $70 and the BS1-IC with the carrier board sells for about $50. The BASIC Stamp alone sells for about $40.

The programming package includes an excellent instruction book with 20 different application notes, shown in detail, with both program listings and schematics, for interfacing with the BASIC Stamp. Some examples of these applications are interfacing to an LCD panel, keypad, A/D converter, servo, a stepper motor, sensing temperature and humidity, sending Morse code, infrared control, sonar range finding, and solar power.

The BASIC Stamp II, which is Parallax's new product, has

additional capabilities so they now include an additional booklet with the programming package. Besides the increased I/O lines and speed, the two most outstanding new features are XOUT X-10 (power line remote control code transmission) and DTMFOUT (DTMF tone generation).

You'll need a PC with at least 128K RAM running MS-DOS 2.0 or greater. One 3.5" HD disk is provided with the programming package. The BASIC Stamp uses the Parallel printer port with three wires to the DB-25 plug interface hookup. The cable is provided with the programming package. The BASIC Stamp II uses the computer's serial port; a DB-9 cable is provided with the programming package.

The Stamps are powered most conveniently, using a standard alkaline 9V transistor radio type battery which snaps directly onto the carrier board.

I can recall my first experience programming my first BASIC Stamp. Within five minutes, I loaded in a short program, which made an LED that I'd connected to one of the I/O lines blink. I was very excited about being able to control a device through my PC keyboard. The next thing I did was hardwire a DTMF decoder IC onto the prototyping area and develop a program to decode touch-tone commands. I made several remote control devices with the BASIC Stamp to use with a pair of HTs.

Now I'm hooked not only on soldering components together, but also on sketching flow charts and developing programs to try out with the new stamp in my collection, the BASIC Stamp II. Try one—you'll like it!

For more information contact: Parallax, Inc., 3805 Atherton Road #102, Rocklin CA 95765. (916) 624-8333.

Persistence Wins

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I was still in shock when I went upstairs to take my Novice written and I thought I did okay. I was sitting down when I heard over the simplex, "Tell Mr. Waters he will have to take another test." I thought this meant I had failed the written. I thanked the test staff and left to join my sons on a Scout trip, thinking I could always take the Novice written again.

I started studying again that night, and I wondered how I had failed when I did so well on the computer.

On Tuesday night, I got a letter from Gene Whitehurst asking me why I had left without taking the Technician written, since there would have been no additional charge. He enclosed the CSCE—for 13 wpm and Element 2. I would be receiving my license in six weeks. I went to work that night on Technician study, thinking I had only a year to pass General written. By June, though, I had done it. I got my General license in August.

I thought there I would stay, never hoping to get to 20 wpm and Advanced was a 500-question pool, but a fellow lawyer called up—Madison Jones, then KB5ZMH. He wanted to say hello. We became friends. Then the so-and-so upgraded to Extra (AB5TV) and started talking about less crowding for QRP contacts.

I bought the Advanced study materials, which is all regulations, procedure, theory, and antennas, my favorite, and took the test on a Saturday. I wasn't ready. The computer

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Number 30 on your Feedback

How Much Are Those Decibels Worth?

A survey of amplifier costs and the resulting S-units.

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Altamont NY 12009

Thinking of purchasing an HF amplifier? What output do you want: kilowatt, legal limit, or California kilowatt? Perhaps you're happy to operate with only 100 watts, which is the typical output of today's transceivers. So what is the *real* difference in signals at the receiving end, as compared to the output signal at the transmitting end? And what are the dollar costs for these S-meter differences?

First, a basic: Each time the final RF output power is doubled, there is a power increase of 3 dB. A gain of 3 dB on HF is generally considered to be the least discernible change at the receiving station. An increase of 6 dB is one S-unit and can be considered a worthwhile gain (Note: S-units vary between receivers, though they shouldn't). The following dB gain figures are based upon an initial RF output power of 100 watts:

Amplifier Gain	Power Output
6 dB	400W
9 dB	800W
10 dB	1000W
12 dB	1600W
15 dB	3200W

Small amplifiers

A power gain of 6 dB can be achieved with a small amplifier which usually uses four sweep tubes. These amplifiers offer an economical entry to moderate RF power gains; however, they must be handled carefully since the tubes won't stand prolonged tune-ups. Such amplifiers were plentiful a few years ago; however, I am unaware of any being made now. There are several different models available used, generally selling for $150–$250.

Kilowatt amplifiers

The next step is the kilowatt. Used kilowatt amplifiers generally use four 811A tubes, two 572B tubes, or a single 3-500 tube. New kilowatts use either the single 3-500 tube or four 811A tubes. Output levels are around 800-1,000 watts, for a 9 dB or 10 dB increase above our 100 watt input level. New kilowatt amplifiers cost from $1,100 to about $1,500. Used kilowatts start at about $300 (more if you want 160 meter and WARC band coverage). One exception to these prices is the Ameritron amplifiers using the 811A tube. The three-tube unit (AL811) is rated at 600W output and sells for under $600. The AL811H uses four tubes at 800W and sells for a little over $700. It's a new amplifier at a used amplifier price, and the difference in dB between 600W and 800W isn't really significant. In between the kilowatt and the small sweep tube amplifier lies an area of 500W and 600W solid-state amplifiers. Generally, these are easy to operate, requiring no tune-up. Some models interconnect with the transceiver and track band changes and/or make antenna selections. Prices vary from $1,100 for the Ameritron ALS600 (with a built-in power supply) to nearly $3,000 for a full-featured ICOM IC-2KL. Solid-state amplifiers require no tuning and produce no filament heat. They are, however, expensive for the amount of power gained!

> **"You don't need an amplifier to make contacts, but it sure can make life easier."**

QRO

The last legal step is the full-power amplifier, capable of developing the amateur limit of 1,500W PEP output. Amplifiers in this power class typically use two 3-500 tubes, a single 3CX-1200A7, an 8877 tube, or a 4CX-1600U. Many of these amplifiers are capable of producing slightly more output than that legally allowed.

More than the law allows? Let's look at the 3 dB rule again. In order to make a discernible difference at the receiving end, your output must increase by 3 dB. That means you'd have to increase your 1500W legal limit to 3,000W to make a difference on the other end. The difference between running your amp at 1,500W and at 2,000W will not be noticed. It is, however, illegal!

New amplifiers in the legal limit class generally sell in the area of $1,800 to $2,300. However, top-of-the-line units such as the Alpha series sell for up to $6,000. Used 1,500W amplifiers start at about $800 (more for 160 meters and WARC bands).

The cost of decibels

Here is the lowest cost you'll probably find for each power increase:

Amplifier Gain	Power Out	New Cost	Used Cost	$/dB
6 dB	400W	N/A	$150	$25
9 dB	800W	$700	$300	$78
10 dB	1000W	$1000	$500	$100
12 dB	1500W	$1800	$800	$150

Notice the difference in dollars/dB between an 800W amp ($78/dB) and one that puts out the full legal limit ($150/dB). If you invest $1,100 more to get from 800W to 1,500W, the S-meter on the receiving end will go up about *half* of an S-unit. Is it worth it? Only you can decide. The cost-per-dB ratio gets even higher as you consider better equipment. A full-featured kilowatt output solid-state amplifier, such as the ICOM IC-4KL, lists for nearly $9,000, or $900/dB.

Used amplifiers

Older amplifiers, such as the Heathkit SB-200, using two 572Bs, or the Collins 30L1, using four 811As, make excellent general-use kilowatt amplifiers. You may need to use a relay box on the keying line to protect some solid-state transceivers from high switching voltages. Many older amplifiers sell on the used market for $300 to $600, depending upon their appearance and tube condition. Be aware that 160 meter and WARC band coverage does not exist on most older amps, whether kilowatt or legal limit versions.

Tubes

Tube costs are a factor when buying any amplifier, since at some point in time you will be faced with buying a replacement. The tubes in used amplifiers are always an unknown factor and replacement costs should be considered prior to making a purchase.

Sweep tubes sometimes sell for less than $10 each, but can go higher than $20. For other amplifiers, the Russian-made Svetlana 811A tubes sell for under $20 each, 572B pairs sell for about $95, and 3-500s start at about $110. When you get to the more exotic tetrode tubes, the prices go up quickly: 3CX800A7 at about $300, 3CX1200A7 at just over $400, and 8877s at better than $600 each.

Remember, a kilowatt will sound the same regardless of what tubes are producing it.

When a kilowatt is not 1,000 watts

Watch out for those advertised power claims; they can be devious and misleading due to confusion between input and output power. Generally, a good amplifier will be about 65% efficient. This means that a manufacturer may refer to an amplifier with one thousand watts input as a kilowatt; however, that amplifier would only provide 650 watts output. The examples used in this article are based upon output power.

Amplifier observations

You don't need an amplifier to make contacts, including DX and contesting. There are thousands of hams using 100 watt transmitters and wire antennas, all enjoying their share of DX and contests. It is the antenna first, then the power level, that counts, and somewhere between the two is the operator whose skills bring about many more contacts than brute force alone.

Seldom do local contacts (75 meter nets, for example) require the use of an amplifier. After all, we are supposed to use only the power necessary to maintain communications. Unnecessary amplifier use serves to clog up the bands with QRM and make the electric power companies richer.

Too often an amplifier is used as the means to attain a good signal report, when the same good report could have been had if the antenna system was improved (at much less cash outlay than the cost of an amplifier). This statement is very often the case on 160 and 75 meters and, to a lesser degree, applies to other bands as well.

A directional antenna such as a three-element yagi or a two-element quad will concentrate your signal and give about 7 dB gain in a single direction (using a 100W transceiver, this is the equivalent of 500W into a dipole). A tower and yagi/quad can be expensive; however, there are many wire antenna configurations that are equally effective, costing only a few dollars and requiring only a little time to put up.

Some bands, such as 15, 12, and 10 meters, do not play the amplifier game well. Propagation-wise, these bands are either open or they are closed. No amount of power will routinely support communications at a level any greater than 100W will do.

A place for amplifiers

It is not uncommon for an amplifier to make the difference between getting through and getting that QSL. As an added feature, amplifiers are nice in the winter. The ones with real tubes provide a warm glow in the shack and help heat it as well!

Persistence Wins

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said I was only averaging 32 to 36 right, and you need 37 out of 50.

I had bought Gordon West's tapes, Jerry Ziliak's tapes, and Radio Shack's book (also by Gordon). I finally committed two formulas to memory. The test was at a library. The answer sheet had two rows of blanks. You go down the sheet, filling in the blanks, then start out at the top of the other half of the page. I finished and turned it in.

One of the VEs started grading. He ended the first row of 25 questions with only three marked wrong. He looked up and said, "So far, so good." I missed five on the other side.

"Take the Extra," the VEs said.

"I'm not ready," I said.

"If you haven't studied, you won't pass it, but take it anyway," they said. "It will be good practice and you never know." Where had I heard that before? I took it, and, as I was turning it in, I saw a ham I knew, Maurice, sitting at the VE table, turning in his 5 wpm test for the Plus upgrade.

"I think I could have passed it if you'd have let me write down the dots and dashes," Maurice said. "Then I could have gone back and transcribed."

"Ha! The Wayne Green Novice Code strategy," I, a *73* subscriber, thought.

The VE leader said, "I never said you couldn't do that," and the room fell silent. Maurice looked at him for a full 10 seconds.

"I'd like to take another code test, please," he said. I turned in my Extra written. It wound up with a lot of red on it—my first ham test failure.

"You didn't do so well that time," the VE said, handing me a CSCE for Advanced. Even so, I was higher than a Gigahertz (Maurice got his upgrade, too). Today I bought the Extra book, and the 20 wpm tapes. Nothing ventured...

JPS Communications NIR-12

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can pull out a certain voice with a center frequency of 1100 Hz and a 1000 Hz bandwidth, copying voice frequencies between 600 and 1600 Hz. It's like the IF pass control on some receivers.

Those are the four modes available with this filter. A significant advantage of the NIR-12 is the ability to use them all at the same time, including cutting the bandwidth when using the NIR mode, as I mentioned.

Some of the artifacts created by the NIR mode can be reduced by using the dynamic peak mode, and, many times, both can be adjusted for best overall noise reduction. Of course the notch filter is always useful with voice modes.

Additional features

You can also use an NIR-12 for transmit audio processing. This is most useful if your microphone is picking up a lot of ambient noise. You'll have to provide your own switching and preamplification if you want to use the same unit for transmitting and receiving, but there's no provision for resetting the controls for different transmit and receive settings, so you're better off using the unit on either TX or RX — but not both.

The NIR-12 provides a line level output that's not controlled by the volume control for things like TNCs, RTTY demodulators, or modems. A headphone jack for both stereo and mono headphones is also on the rear panel. A "bypass" position lets you switch the unit into bypass mode through your transmit/receive relay so you can monitor your transmitted signal (especially CW) without going through the NIR-12's delay.

The instruction manual is comprehensive and clear. It has sections providing a brief description, and instructions for quick operation, controls, and operation. The result is that a cover-to-cover reading of the manual reveals the same information in varying detail three or four times. This may lead to some head-shaking, but you *will* know how to use it by the time you're done.

You also get a schematic; it's barely readable, but JPS is to be commended for putting one in at all. There's a programming interface available if you want to develop your own filter algorithms, and there's a section on the limitations of the NIR-12. The reality is that there are still some signals that are so far down in the noise you can't hear them, even with 1996 technology. Obviously noise algorithms and more powerful processors are needed and will continue to evolve.

Since the DSP chips need time to do their thing, there is a measurable delay through the unit, especially in NIR mode, where the delay of 130 milliseconds renders the TOR modes unusable in normal ham operations. For all the other modes, the delay is specified as less than 19 milliseconds, which allows normal TOR operations.

The NIR-12 is better than the NIR-10 in every way, but we still have a way to go before I will stop complaining about computer noises! The emitted RFI from the NIR-12 is far less than that of the previous model, but there's still a little and for some reason it still carries the less restrictive FCC Class A rating. Equipment that's well-shielded for home use normally carries a Class B rating.

The other noise is what comes out of the audio output. Again, it's better than the NIR-10 and better than some competing units, but I still hear its microprocessor running in the background through the speaker. JPS rates the output at 2 watts with 10% distortion. I'd prefer less, and DSP units that are 10 times the price achieve that.

For my money, I haven't yet found anything better than the NIR-12; it works well, and JPS's reliability and customer support are superb. They have regularly come out with customer-installable firmware updates for their units. I continue to use the unit for ham radio and broadcast monitoring, where I can set up the unit and know that the tape I'm recording won't be ruined when I turn on a computer. While it isn't the only noise reduction I have, it is the most generally effective.

QRX . . .

Continued from page 9

from the village, many with only the clothing they were wearing. Most evacuees were taken to nearby Waupaca.

Amateur Radio Emergency Service (ARES) personnel contacted State Director of Emergency Government, Al Shanks, later that morning, who instructed ARES to activate communications and set up a command post at the Red Cross Center in Waupaca. At DEG's direction, amateurs also provided communications for the incident command post at Weyauwega, at the Fremont WI Fire Station (where all the Weyauwega fire department's equipment was taken to be housed and maintained), and at a road block check point at State Highways 10 and 49.

Communications were provided for Red Cross shelters in Waupaca. Circuits were also active from Waupaca to the State Emergency Operations Center of the DEG in Madison, where RACES station WC9AAG was in operation 24 hours a day for nearly two weeks. Two meter repeaters, the 3993.5 kHz RACES frequency, and some packet radio nodes were used for the long-haul path to Madison.

Ham Radio Operator Lauded for Helping Save Sinking Yacht

Los Angeles: As an amateur radio operator, Bob Karon has frequent conversations with people from around the world, swapping stories about family, sports, or new radio equipment with other enthusiasts.

But a recent transmission, heard as he was testing a new amplifier, sent the 46-year-old ham operator from Los Angeles leaping to his feet; a frantic voice was calling, "Mayday! Mayday!"

Within seconds, he had begun a search by radio and telephone that, with the assistance of the U.S. Coast Guard, ended in the rescue of four people aboard a yacht sinking in the Caribbean Sea at night with a storm moving in.

"This all came out of the blue," he said after receiving a letter of commendation from the Coast Guard. "I wasn't expecting an emergency call."

The night of March 18, he was speaking with another ham operator in Naples, FL when he heard the mayday call on the same frequency.

In the first few minutes of talking to the sinking craft, Karon found out that it was a 44-foot Canadian yacht named the Cambria, carrying owner, Kenneth Cunningham, his wife, and another couple.

The yacht had been grounded on a reef about 150 miles southwest of Jamaica, Cunningham indicated in static-interrupted transmissions.

The yacht had a hole in it, water was coming in fast, and a storm was approaching. . Cunningham said that the waves were growing and the boat would go under within the hour.

"They sounded terrified," Karon said. "It sounded like they had very little time."

Karon first telephoned the Coast Guard in Los Angeles, and was transferred to the Miami station. With the phone to his ear and microphone in hand, Karon was the only link between Cunningham and the potential rescuers.

"I had to make sure (the Coast Guard and the sailors) got absolutely correct information about the yacht and its location," Karon said. That turned out to be very difficult.

The grounding left the vessel on its side on the reef and jolted the communications system out of place, including the radio antenna, which was almost touching the water, Cunningham told Karon.

"The signal was weak and full of static," Karon said. "A lot of times I would say something and the response would come back, 'Negative,'" Karon said, meaning Cunningham was trying to correct him.

The Coast Guard determined that its closest rescue team was 2 1/2 hours away, but the Nord-Jahre-President, a freighter, was about 25 miles away and could reach the Cambria in an hour and a half. It might be too late, Cunningham told Karon, but it was their best chance.

Karon was connected by the Coast Guard to the Nord-Jahre, which accepted the mission, changed course toward the Cambria, and took over for Karon, who learned the rest of the story when he got the letter from the Coast Guard.

"Your professional and humanitarian actions are heartily commended and demonstrate the finest traditions of assisting mariners in distress," said Coast Guard Capt. Robert Gravino in his letter to Karon.

"This is the first time that I know of that someone picked up the call before the Coast Guard," added Petty Officer Scott Carr, who aided in the rescue from the Miami station. by Jose Cardenas, *Los Angeles Times*. Reprinted from *Sarasota Herald-Tribune* / Sunday, April 7, 1996.

Home-Brew Whip Antennas

Make field-strength whips from your basement junk pile.

J. Frank Brumbaugh KB4ZGC
PO Box 30 C/O Defendini
Salinas PR 00751

Many hams would like to have a cheap and simple way to make collapsible whip antennas that would mate with field-strength meters and other test equipment. Others would like to replace the rubber ducks on their handhelds with quarter-wave whips. A whip which would collapse to about six inches and extend to about 19 inches could be used on the 2 meter, 1-1/4 meter and 70 cm bands, and would be ideal for a dual-band transceiver.

Many mail order dealers offer small collapsible whip antennas that vary in length, diameter, and number of sections. However, usable whips can be salvaged from old TV rabbit ears and small AM-FM radio receivers.

Depending upon the outside diameter of the base of the whip chosen, it can be mounted in a UHF or BNC connector so it will mate with similar connectors on your ham equipment. A BNC to UHF adapter will enable a single whip to be mated with either connector on equipment. The exploded views in **Fig. 1** illustrate clearly how to mate a whip to a male connector, both UHF and BNC.

Solder a short length of bare wire to the base of the whip. It may be necessary to file through the shiny coating on the whip to allow the solder to adhere adequately. Use of a solder gun is recommended because of the thermal mass of the whip.

UHF

Insert the wire from the base of the whip through the center contact in the plug body. Making certain the wire and whip base do not touch the body of the connector, solder the wire into the center contact. While holding the whip centered in the plug body, inject hot glue or epoxy cement into the space between the whip and the plug body. More hot glue or epoxy can be injected through the solder holes in the plug body: this will strengthen the bond. When the glue has cooled or the epoxy has set, slide the sleeve of the PL-259 over the whip and screw it into place on the plug body. Use an ohmmeter to make sure that there is no short between the whip and the plug body, and that the whip and center contact are continuous.

BNC

The wire soldered to the whip must be thin enough to fit into the hole in the end of the contact pin. Cut this wire to a length that, when inserted into the contact pin, which is then inserted fully into the plug body, ensures that the base of the whip is within the plug body and that no short to the body exists. This may require some cut-and-try. When it's at the proper length, solder the wire into the contact pin and remove any excess solder from the outer surface of the pin.

"Usable whips can be salvaged from old TV rabbit ears and small AM–FM radio receivers."

Note: Discard the nut, washer, gasket and clamp from the BNC: these will not be used.

Insert the contact pin into the plug body and make sure it is firmly seated. The base of the whip must be partly inside the plug body, but not shorted to it. Inject hot glue or epoxy into the plug body between it and the base of the whip. Hold the assembly until the glue or epoxy is set, making sure the whip is not shorted to the plug body.

Additional hot glue or epoxy can be mounded into a fillet around the whip and plug body of the BNC connector, or the PL-259 if this is used. This will add strength and provide a neater appearance. Use a wet finger to mold the fillet into a neat appearance. Always check with an ohmmeter for continuity between contact pin and whip, and for no short between whip and plug body.

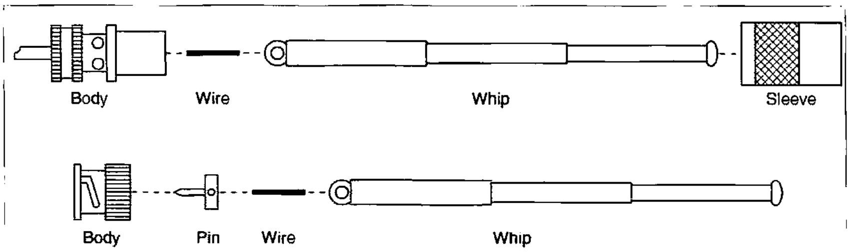

Fig. 1. Whip antennas, exploded views.

LETTERS
Continued from page 6

scene). It is little wonder that many drop out after a year. Shame on you, Wayne, you should know better, but I do understand your frustration. I am one of those who has upgraded. I'm into weak signal VHF SSB, Mode A satellite, packet (home-built BayCom), and Ham-Com CW, RTTY, etc., decoder to decode VHF beacons. Yes, amateur radio is dying, but more accurately is committing suicide. Sure, there has been a dramatic increase in No-Code Techs. It will be interesting to see what percentage of these will renew over the next 10 years. I'll bet it'll be less than 25%. Combine that with the age of the higher class license holders and the future doesn't look good. Perhaps we should replace the CW requirement with tougher exams, including up-to-date technologies.

Mike, I've operated CB in dozens of cities and never had a bad experience, so I feel no shame about CB. I've had some wonderful contacts with interesting people and found most of 'em very helpful to visitors. Yes, the code is perceived as an ogre all out of proportion to the actual difficulty it presents, but we have to deal with this religious belief, not reality. Many of us spend lifetimes not taking a relative few minutes to do things that would make our lives much more fun. Like dieting, for instance. Or eating more healthily. Or improving our educations. As the sunspots heat up our lower bands are going to get hot too, and those poor suckers trapped on 2m are going to miss out on an incredible amount of fun. So, let's try to break the ARRL's insistence on the code test, but let's also make sure those marooned in the ham attic on 2m know what fun they're missing downstairs ... Wayne

Edward Slabe N8TQP. On the very last page of the May issue, in the "Updates" column, you ask for input by anyone who has purchased and built the Super CW Station which *73* featured in the June 1995 issue. Well, let me tell you about my experience with Sam Ulbing and his incredible CW-keyer-reader-tutor-clock.

The assembly was very straightforward and the well-written assembly guide made building the SCS (as Sam calls it) a lot of fun. During assembly I had a few questions on the SCS and was impressed by how quickly Sam answered my questions when I E-mailed them to him.

I've never had so much fun working on Morse code as I have had with this unit. Why? Because this keyer also shows you how well you are sending as your copy scrolls across the screen. I'm sending good copy because I can see how it sounds to those listening. When I send a "C" it won't sound like "N N." And sending is only part of the fun. The other night I was listening to a QSO between two stations who were using keyboard keyers. So what's the big deal? They were sending to each other at 40 words a minute. I followed the entire QSO without missing a single word. Now I am really impressed with my SCS unit. It really held on to the signal with only very slight adjustments of the RIT control over a period of 20 minutes without losing a word as the signal dropped down to an S-2. The tight bandpass of the code reader ignored the noise.

The best part is that I can use the SCS anywhere. It is not tied to a computer. This is great; now I can sit out in the back yard under a nice shade tree with a QRP rig and my SCS. This is the way to enjoy having a relaxed conversation on CW. And if you have a keyer built into your rig, just use it and the SCS will display your copy using the sidetone from your rig.

This unit far exceeded my expectations. I not only have a ball honing my CW skills, I also have a great keyer, and as I grow tired and start missing some of the conversation I can look at the LCD and check my copy.

If anyone is thinking about a keyer, a CW tutor, or a CW reader, you should contact Sam Ulbing and check out his Super CW Station. It is to CW and ham radio what Superman was to crime fighting. The fun is only

Continued on page 62

The JB Keyer

A low-tech solution to good keying.

Richard Koelker KU8K
550 Stanley Road
Akron OH 44312

What has no tubes, no transistors, no ICs, no keyboard, yet can make machine–like Morse code? The JB Keyer.

The JB Keyer makes self-completing dots and dashes. When idling, it takes zero standby current. It's not very sensitive to power supply voltage and takes about 25 mA from a 12 VDC source when generating characters. It can be cheap, depending on your junk box. It need not be much, if any, larger than a keyer built using ICs.

"The JB Keyer can be cheap, depending on your junk box, and it need not be much, if any, larger than a keyer using ICs."

The schematic for the JB Keyer is shown in **Fig. 1**. Several of these keyers have been built using relays and capacitors removed from old circuit boards. All provided acceptable performance without careful parts selection. It should be noted, however, that electrolytic capacitors are generally wide tolerance parts (+80% to −20%, for example), and in some cases parts may need to be hand–picked. The pull-in and drop-out characteristics of the relays used also affect the speed and mark/space ratio.

How it works

The JB Keyer makes use of the difference between the "pull-in" and "drop-out" voltages of the relays used, in combination with RC time constants that change when these voltages are reached. Refer to the schematic diagram in **Fig. 1**. Relay K1 and the components on the left side of the schematic dictate the "on time" or "mark" of the keyer; relay K2 and the right hand components determine the timing of the "off time" or "space." When the key lever is pressed to the DOT side, capacitor C1 is charged rapidly through the normally closed contacts of K2, in series with resistor R1. R1 is chosen to be large enough to limit the peak current through the key con-

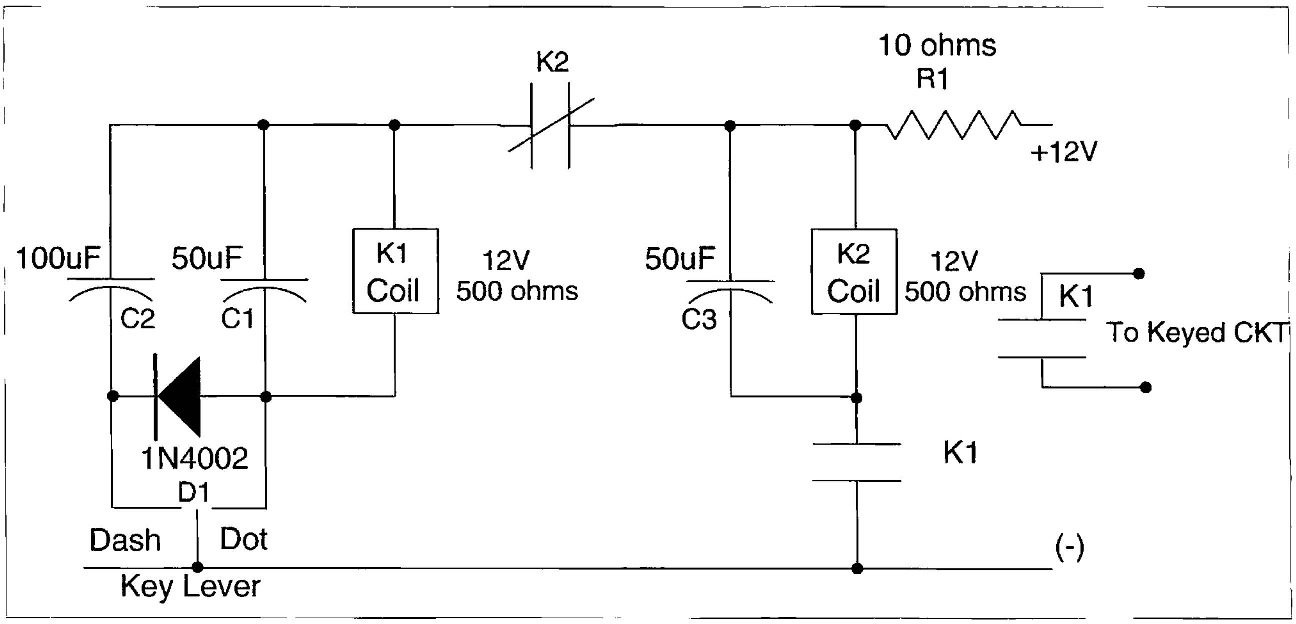

Fig. 1. Schematic for the JB Keyer.

tacts, but small enough to allow C1 to charge rapidly (before the key contact is opened). As C1 charges it will pass the pull-in voltage of K1, causing it to operate. When K1 operates, it closes its normally open contacts, completing the circuit for C3 and R1. When C3 reaches the pull-in voltage of K2 the relay throws, opening the current path to C1 and K1. Even if the DOT contact is still closed, K1 will be unable to pull in again until C3 discharges through K2. If the DOT contact is held closed, the K1-C1 time constant will determine the "dot" timing, and the K2-C2 time constant will determine the spacing between dots—which should be equal to the length of the dot itself. A second set of relay contacts of K1 keys the transmitter, ideally with a 50% duty cycle if both the left and right time constants are equal.

By definition, a dash is the length of three dots. If the DASH contact is closed, C1 and C2 appear to be in parallel (through D1) and their values add. The dash time constant therefore consists of C1 + C2 combined with K1, and will be three times as long as the C1-K1 combination. The dash will be self-completing as before, and the space following it will be the length of one dash, as expected.

Choice of relays

The coils of the relays used in my versions of the JB Keyer are rated at 12 VDC and have 500 ohms of resistance. These relays will pull in at less than 12 volts and, once energized, will stay thrown when the voltage across the coil drops well below the pull-in voltage. These relays, therefore, have a type of "hysteresis," which is essential to the operation of the JB Keyer. Although they will not pull in at the lower voltage, they do not drop out, once energized, until the voltage across the coil falls to the lower value as the capacitor across it discharges. Virtually all relays have some amount of hysteresis, so it's worth experimenting with whatever you have in your junk box.

Capacitors

Because of the high capacitance values required, the only practical types to use are electrolytic types. These capacitors are polarized and can be installed correctly in only one way. Polarity markings must be observed! These capacitors are generally wide tolerance components. If marked 100 µF, the actual value of an aluminum foil electrolytic capacitor may be as little as 80 or as much as 180 µF. On the other hand, another type of electrolytic capacitor, the tantalum electrolytic type, can be obtained in closer tolerance values, but they are more expensive.

In addition, as electrolytic capacitors age, their capacitance value decreases. Many radio and television problems are due to dried-out electrolytic capacitors. The humming often associated with old tube-type radios is usually an indication that dried-out electrolytics need to be replaced. The only sure way to know the condition of an electrolytic capacitor is to test it with a capacitance tester or substitute a known new one.

In other words, if you use salvaged capacitors you may have to experiment. On the other hand, *all* of my parts were salvaged and performed acceptably. While new capacitors will probably be higher than their marked value, used ones may be off considerably from their nominal value in either direction, but probably on the low side.

Speed control

The capacitance values for the original model of the JB Keyer were chosen to provide a comfortable speed for mobile operation. In the interest of small size, no speed control was provided. A hi/lo speed operation can be obtained by switching in fixed resistors across both relay coils. 1,000 Ω is a suitable value. A two-gang variable resistor in series with these added resistors would give continuously variable speed.

Construction

The relays specified have their contacts arranged on a 0.1-inch grid. The keyer was constructed using point-to-point wiring on a 1 x 2-inch piece of scrap perf board. The small size of the JB Keyer allows you to tuck it away inside the transmitter, if you want.

In case you wondered, the "JB" in JB Keyer refers to the origin of the parts used in the circuit—my Junk Box.

Lubricating a Transceiver's Fan Motor

Cut down on background noise and prolong the motor's life.

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The fan motors in most amateur 100 watt HF transceivers should be lubricated every now and then, particularly if their sound changes noticeably. These fans are absolutely essential for keeping free air moving in and around the transceiver final amplifier's heat sink, even more so when using the rig on AM, FM, or any of the data modes. The fan motors in my two Kenwood TS-430S HF transceivers became noisy recently, so I was more or less forced to remove and lubricate them. What follows is a detailed explanation of the procedure that I used in the TS-430S, but it will apply in part to other transceivers in the same class.

"Resist the temptation to simply 'shot-gun' spray the little guy; it will likely do as much harm as good."

Getting inside

The motor in the TS-430S is easily accessed by removing the four Phillips-head screws around the plastic "fan guard" that faces rearward on the transceiver. Then there are three more, recessed and smaller, Phillips-head screws to be removed in order to free the fan motor from its mounting configuration on the transceiver. Mark the terminals "+" and "-" and unsolder the shielded coaxial-type cable that feeds 12 VDC to the motor. Now it's completely free. The bracket with the three mounting "ears" can be left on the motor's housing for the rest of the operation.

Now for the fun part! The motor bearings are not accessible from the outside; the motor's housing has to be disassembled to gain access to these bearings, where the oil must go. Resist the temptation to "shotgun" spray the little guy; it will likely do as much harm as good, since the oil needs to be only in the bearing surfaces themselves. First, remove the white plastic fan blades, loosening the tiny straight-blade set screw in the mounting collar. Unfortunately, the motor that Kenwood uses can't be "cleanly" disassembled by unscrewing nice little screws. There are two small bent-in tabs holding it together instead! The only way to get it apart is to bend those two little tabs up and slip the rear white plastic end-bearing housing away from the main steel motor housing section. This means you can't take it apart too many times before the tabs break off, so try to do a good job the first time around. I used a small jeweler's screwdriver to start the bend in those tabs, finishing with a small pair of long-nosed pliers.

In my own motors, the inside was clean, but without any noticeable lubrication. I used a Teflon®-based lubricant (Radio Shack™ # 64-2301A) myself, but any of the modern, long-lasting lubricants intended for high speed should work well. You'll want to apply just a small amount—a couple of drops—on both the front and rear bearing surfaces (where the motor's shaft touches the motor housing bearing surface). To get to the front bearing surface, you'll have to pull out the rotor section, overcoming the resistance of the magnets around it, and apply the oil to the shaft surface just forward of the windings themselves. The rear bearing is a bit easier, since there's a small "cup" and plastic washer at that point. A "pinpoint" lubricator, like the one mentioned above, is almost a must.

There should be no need to remove the rotor winding assembly from the commutator's bushes, but if it happens accidentally while working on the inside of the motor, the rear shaft of the rotor can be reinserted into the rear bearing cup, with the plastic washer in place (its shoulder pointed toward the commutator segments) and the brushes very carefully spread and placed once again against the commutator. The brushes are very delicate but do have a fair amount of spring in them, so take your time and you should have no trouble with the task.

Now carefully slide the assembly back together and bend the two locking tabs back down far enough to hold the housing securely in place. Run the motor for a few minutes on your workbench, using a small 12 VDC power supply, or even a 9 volt battery. If everything seems well, solder the cable back on and reinstall the fan motor package. In both cases, with my units, it made a tremendous difference in the amount of noise generated by the fan motor during operation, which was almost unnoticeable after a good lubrication.

There's a good chance that the small motors used in other ham transceivers for cooling the final amplifier's heat sink are constructed in a similar manner, though some may be more easily disassembled because thay have small screws instead of a locking-tab construction. So don't be afraid to give it a try, regardless of the particular transceiver you might own. Just do it carefully, when you're not rushed, and document your steps as you go, noting the correct placement of any small parts within the motor's innards. You'll prolong the life of the motor significantly, as well as cut down on the background noise in a positive way.

NEVER SAY DIE

Continued from page 7

hams were teen-agers. Today it's around 12%, tops. That's not the key to keeping the hobby alive.

Sales point #1 is fun. It's fun to make friends over the air. It's fun to work DX. Amateur radio is a whole bunch of fun hobbies, which I try and cover with articles and columns in *73*.

Sales point #2 is the fantastic career path that an interest in amateur radio provides. I hope there's no argument that the world is going to need millions of technically literate workers in the 21st century. The electronics, communication, and computer industries are going to need people to develop, build, sell, operate, and maintain the electronic systems of the future.

Sales point #3 is adventure, and amateur radio has plenty of that if you have the guts (aka initiative) to take advantage of the opportunities. My life has been filled with adventure as a result of my interest in amateur radio.

I was having a ball experimenting with 2-1/2 meters back before World War II. Heck, 10m was still mostly an experimenter's band in those days. I built my first 2-1/2m walkie-talkie in 1939 and wrote about it in the school literary magazine. When my ticket arrived, I made my first contact with it, working Dexter Miller W2MSV, as I was walking along the street. Today I'd use an HT that fits into my shirt pocket, but then my walkie talkie was in a Bud box about 10" x 10" x 10".

Came WW II and my first really big adventure. I joined the Navy in 1942 as a radio technician and went to their electronics schools. That led to my being assigned as an Electronics Technician to the *USS Drum* in 1943. After five exciting war patrols, I was transferred to the Submarine Base in New London (CT) to teach electronics in 1945. You can read about my submarine days in my *Submarines in WWII* book ($8). I got discharged in 1946 and, not knowing any better, went back to college.

Then there was my adventure as KC4AF on a DXpedition to Navassa Island in 1958. Now, that was exciting, complete with riding out a hurricane, and almost getting killed a couple of times. And my being appointed to the US team to represent amateur radio at the ITU in Geneva in 1959. And how about Operation World-Wide, where I operated from an Air Force C-54 as we flew around the world, visiting 23 countries?

Less epic, but still exciting, were my many mountaintop VHF expeditions. How about working seven states on 10 GHz? Adventure is there if you keep your eyes and ears open.

Like operating from Swaziland and Lesotho. Or even a few days operating from St. Pierre Island, just a short flight from Halifax. Or cranking the generator for Field Day on a bicycle (last year at Boulder).

Every now and then I get a letter from Ken Miller K6IR from some weird place or visiting with someone famous, all as the result of amateur radio. Ken and I had a great time visiting Asia together. Several times. I used to escort groups of up to 250 hams and electronics people on tours of the Asian electronics shows every October, attending shows in Tokyo or Osaka, Taipei, Seoul, and Hong Kong. Every trip was an adventure. I can't wait to set up a web site and put about 10,000 color slides of my trips on it. Plus pictures of hundreds of well-known hams.

I've been asking you about your ham adventures, so how about it? Well, when talking with the kids, you can point to what's possible in the way of adventure.

Now let's get those kids excited and licensed.

Meihem

When a manuscript came in from Ray Eisner proposing an updating of English spelling which might be launched via amateur radio, I remembered a wonderful story in *Astounding Science Fiction* 50 years ago, back when I still had a full head of hair. There was a story, "Meihem in Ce Klasrum," by Dolton Edwards, which made a lot of sense. Well, Ray has picked up the ball for us.

How come English has so many letters that aren't pronounced, but have managed to stay in the dictionary, much to the frustration of children and foreigners trying to learn our crazy-quilt language? A couple hundred years ago they *were* pronounced. It's just that we've had several generations of lazy talkers since then, so today we pronounce tough as tuf and might is mite, don't you k-no-w?

The main problem I found with Ray's well-thought-out article was that it was 16 pages long! Yoiks. Also, there was just the tiniest question in my mind as to whether 100% of the readers would be as excited about the whole idea as I. People will go to extremes not to change habits and here was an idea for updating our language which meant making a big change. If Ray had proposed just one little change it might have a chance, but instead he's rebuilt the English language in a very practical form.

Ray's system gets rid of letters with two sounds, letters which aren't needed, double letters, silent E's, and so on. Sure, it makes sense and would make it infinitely easier to learn to spell.

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Just Who *Did* Invent Radio?

If you're sure you know, the answer may surprise you.

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There's a lot of interesting history in the realm of radio and its child, television. The players include inventors, businessmen, performers, and lots of other people. Unfortunately, the vast majority of this information has not been made available to the masses!

Marconi

First of all, ask the average American, "Who invented radio?" If they know at all, the reply will usually be "Marconi." For most of my life, and that of my parents and grandparents, *the* inventor of radio has been, according to all the history books, Guglielmo Marconi, born in Bologna, Italy, on April 25, 1874. Marconi was the son of a very successful Italian businessman with extensive business ties to Great Britain.

Marconi was interested in wireless telegraphy (radio) from an early age, and conducted experiments on his father's estate starting in June of 1895. Later that year he was able to send messages up to one-and-a-half miles.

Seeing the commercial potential of communications with ships, the 22-year-old Marconi went to England where, in 1896, he was granted his first patent on radio communications. Later, with the help of his father, Marconi contacted a number of influential British businessmen, and the Marconi Company was formed to develop wireless communications. Until about 1920, this company dominated the radio scene worldwide.

Lodge and Fessenden

However, several years before Marconi even started experimenting, as early as 1888, Oliver Lodge (later Sir Oliver), a professor at Liverpool University, was conducting experiments in wireless telegraphy. Lodge was granted a patent on his system (which, by the way, was the source of the receiving detector used by Marconi—the coherer) in May 1897. This patent was purchased by Marconi in 1911.

"*By the mid-1890s Fessenden was transmitting voice and music from the shore to people aboard pleasure boats on the St. Lawrence River.*"

At the same time, a Canadian university professor (Western University) named Reginald Fessenden was experimenting not only with wireless telegraphy, but with voice and music transmission as well. Also, he was interested in the radio control of boats. By the mid-1890s Fessenden was transmitting voice and music from the shore to people aboard pleasure boats on the St. Lawrence River.

Dolbear

As you can easily see, both Lodge and Fessenden predate the experiments of Marconi but they were late-comers, for, in 1886, the United States patent 350,299 had been issued to Amos Dolbear, a physics teacher at Tufts College. In fact, for a time, Dolbear was able to keep the Marconi Company from operating in the United States because of his patent for a wireless telegraphy system (which, by the way, was virtually identical to the system used by Marconi)! Later, the Dolbear patent was purchased by the Marconi Company, thus allowing them to use wireless in the United States.

Loomis

Dolbear was also late on the scene, for, as early as August 15, 1858, an American dentist named Mahlon Loomis was beginning a series of experiments in wireless telegraphy within the state of Ohio! With the interruption of the American Civil War, Loomis continued his work. In October of 1866 he sent signals between two mountaintops, about 15 miles apart, in the Blue Ridge Mountains. Senator Samuel Pomeroy of Kansas and Representative John Bingham of Ohio were present at this demonstration. Both men later gave much support on Loomis' behalf in the U.S. Congress.

In January of 1869, Senator Charles Sumner of Massachusetts introduced a bill into Congress to appropriate $50,000 (well over a million dollars in present-day purchasing power) for development of Loomis' system. This bill languished in committee for two years, at which time Rep. Bingham introduced a bill to incorporate the Loomis Aerial Telegraph Company, giving it the right to issue up to two million dollars worth of stock. This bill stated that no money was to come from the U.S. Government (one of the reasons the original bill was stalled in committee).

In early 1873, President Grant signed the bill into law, and a few months later, on July 20, 1873, Loomis was granted U.S. patent #129,971 for the invention

of his system. Unfortunately, Loomis' company had gone bankrupt during the stock market "panic" of 1869, and he was never able to garner enough financial support to put the system into operation.

Although Loomis died in 1886, he left his mark in other areas. He was not only an inventor in the area of radio, but he also held a number of patents in the field of dentistry, including methods of making false teeth and specialized filling materials and methods. Some of his ideas are still being used today!

Patent disputes

There are certain things to be noted about these early inventors. The first is that during this time period, patent offices would issue patents on working items only, either full-sized or models. Thus, Loomis, Dolbear, and the others had to actually demonstrate that their equipment worked! There was no patenting of ideas at that time.

Next, although most of the people involved were university types, they did not publish papers to the extent that papers are published today. Also, there was a lot of nationalism involved with something of such possible importance as communicating without wires.

Marconi had established a consortium of powerful British investors. Several of these were members of Parliament, and the rest were in a position to command the ear of that governing body. Because of this, both Lodge and Fessenden (Canada being a member of the British Commonwealth) were effectively silenced by governmental actions. The Marconi Company soon dominated the wireless (radio) scene.

From about 1900 until 1943, there were a large number of patent rights battles in the courts of the United States and Great Britain. Little by little, Marconi's patent empire was voided until, just before his death in 1943, his last patent was vacated in favor of Nikola Tesla.

In fact, Marconi's list of patent fights included almost all of the inventors and pioneers of radio communications. People like deForest, Fleming, and others were in an almost constant fight with Marconi and his company. Because of these lengthy patent battles, the British Government did not wish to aid those fighting against the British-based Marconi Company. Therefore, they insisted that Marconi was the inventor of radio. It is unfortunate that this misconception is still being taught today.

Marconi, through the efforts of his British company, did more than anyone else to commercialize radio. However, he really did nothing himself in the actual invention of the systems. Everything he used was invented by someone else, and was actually used in two-way radio communications before Marconi. In Loomis' case, the patent was issued before Marconi was even born!

Because the history books of the early 20th Century taught that Marconi was the inventor of radio, it is still being taught today. This is unfortunate, for there were, in reality, several true inventors (each with a different system type) who were communicating before him. But such is the world of the history text writer.

There are other such tales about grossly wrong history texts, but those can wait for another time!

Repeater Coordination

Boom or bust?

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97.205(c) Where the transmissions of a repeater cause harmful interference to another repeater, the two station licensees are equally and fully responsible for resolving the interference unless the operation of one station is recommended by a frequency coordinator and the operation of the other station is not. In that case, the licensee of the non-coordinated repeater has primary responsibility to resolve the interference.

In my copy of Part 47 of the Code of Federal Regulations, that part of federal law which pertains to the Federal Communications Commission (FCC), this is the *only* reference to coordination of amateur repeaters except for the definition of frequency coordinator in Part 97.3 (20). Unless I have overlooked some other reference, and I have read and re-read the regulations many times looking for such, this is the basis on which all frequency coordination bodies within the areas served by the FCC exist.

"When a frequency coordination body gives coordination to an amateur for the purpose of placing a private (or closed) repeater in operation, that body is, in effect, giving ownership of that frequency to a particular amateur, which is in direct violation of federal regulations."

The unfortunate history

When FM and repeaters first came into vogue in the late 1960s, unfortunately, in some areas, there did exist groups of amateur radio guerrillas who waged "wars" over specific frequencies on which they operated their repeaters. Although most repeater operators tried to cooperate with other repeater operators, there were a few hardheads who absolutely refused to cooperate with anyone. Various attempts were made to bring these operators into the fold, including (I am told) nighttime sorties to repeater sites, pins through the coax, and all sorts of damage done to the equipment.

Of course, such activities are illegal under both civil and criminal law, but such were the activities of a few renegades during the battles of the 1960s. Then, when vigilante justice was abandoned, various organizations of amateur radio repeater operation arose. At the time, there were at least three items on their agenda. The first was to serve as a clearing house for technical data. The second was to influence the FCC during times when the actual existence of repeaters was in doubt. The third item was to serve as a coordination body to help alleviate repeater interference on the very few frequencies then being used.

In most areas, the repeater pair was 146.340 MHz input and 146.940 output. In a few areas, 146.940 MHz was reserved for simplex operation, so 146.340 MHz was paired with 146.760 MHz as an output. But, within a very few years the standard frequency splits came into being. There are explanations why the upper 1 MHz of 2 meters has an inverted split, but that will be reserved for another time. With almost every repeater on the same frequency, turf wars were inevitable. However, as the coordination bodies came into being, many existing repeaters, and virtually all new repeaters, were moved to other, approved, frequencies.

Today's problems

In general, for many years, the frequency coordination bodies have done an excellent job of preventing repeater wars. However, a significant number of these bodies have lapsed into a police state mentality when dealing with repeater coordination. They have forgotten that they have no basis in law for their existence. They threaten, they tell lies, and sometimes they give preferential treatment to certain individuals.

In many areas, frequency coordinators will tell an amateur that no frequency pairs are available in certain bands (primarily the 144 MHz and 440 MHz bands), but when one tries to bring up a repeater, nothing happens. Then it's back to the coordinator who then tells the applicant that these are *private* repeaters, and that the frequencies are not available for use by the general amateur public.

Well, I seem to remember that within the regulations of the FCC that no one owns a frequency. All frequencies available to an amateur, within his license class limitations, can be used. The only restriction is not to interfere with an *ongoing* communication. If no one else is using the frequency, then it is perfectly OK to use that frequency. Period! But, when a frequency coordination body gives coordination to an amateur for the purpose of placing a private (or closed) repeater in operation, that body is, in

effect, giving ownership of that frequency to a particular amateur. This is a direct violation of federal regulations.

For example, in California, according to a fairly recent edition of the *ARRL Repeater Directory,* there are 426 repeater stations in the 440 MHz band located in the northern portion of the state. Of these, 170 are open, and the remaining 256 are closed. This makes a total of almost exactly 60% of the repeaters in the northern portions of California closed. In the southern half of the state there are 452 repeaters listed, of which 38 are open. That makes a whopping 84% of the 440 MHz repeaters in southern California *closed!* Yet, each and every one of these repeaters is presently protected from interference from normal amateur operation.

Is this fair? In my opinion, no way! Is this trend all over the country? You bet your sweet bippy! Is this legal? *No way!* But such are the activities of the majority of frequency coordination bodies in the United States.

Now, I have no problem with closed or private repeaters. The FCC has issued opinions that a repeater operator can restrict the users of his/her repeater. Often, these repeaters are just an excuse for a private phone patch (autopatch) for use by a single, or at most a few, amateurs. Legal? As long as the conversations fall within FCC guidelines; but should the amateur community in general suffer the loss of the vast majority of frequency spectrum to support the whims of a very few amateurs? I think not!

Possible solutions

I propose two possible solutions. The first is to designate a few frequency pairs for use by private or closed repeaters. Since each probably has only a few users, there will be little chance for interference. Often, and I have monitored some of the closed repeater frequencies for quite a while, there is no activity for days, even weeks! Yet the frequency pair is coordinated and thus unavailable to the general amateur public.

The other solution is to continue to coordinate private repeaters and/or allow them to operate on the frequency pairs now allotted. But, when an amateur, or group of amateurs, wants to install an open repeater, the frequency coordination would automatically be revoked and be transferred to the open repeater. In areas in which there are frequencies available, it may take years until the frequency coordination of a closed repeater is revoked. On the other hand, in areas where no frequencies are available, then frequency coordinations might start to be revoked immediately. However, a repeater open to *all* amateur operators should take priority over one with restricted usage.

"A repeater open to all amateur operators should take priority over one with restricted usage."

Amateurs who are now operating closed or private repeaters will not like giving up their exclusive rights to a frequency. But, since this ownership of the frequency is illegal under present regulations, they have no right to this de facto ownership. I cannot blame someone for wanting to have his/her private frequency, but such activities are prohibited by law. Thus, much of the blame must go to the coordination bodies who have allowed and even encouraged this practice for so many years.

Of course, there are amateurs who have gotten frequency coordination for a repeater and who have never placed a machine on the air. Definite time limits should be set (say three months) for a repeater to be placed in operation. If there are very extenuating circumstances, a one-time extension of another three months could be given. Then, no matter what, the frequency goes back into the coordination pool if no repeater is in operation.

Many amateurs are intimidated by frequency coordinators. Unfortunately, some of these people have declared themselves to be demigods, and refuse to face the reality of amateur operations today. It is possible to force the frequency coordinators back into the real world—it just takes a concerted effort on the part of the majority of amateurs.

Anyway, in the urban areas of the country there are just not enough frequency pairs to go around if we continue to allow all the private and closed repeaters to operate with no restrictions. According to FCC regulations, no person can own a frequency. Thus, the practice of allotting our scarce frequency spectrum to a very small number of amateur radio operators must not continue. However, unless a cry is heard from the majority of operators, this will continue to happen, as it does now.

Cry out! Let the ARRL, your state repeater organization, your local frequency coordinator, the editors of any club newsletters you know, and anyone else who can help know of your displeasure with this practice of coordinating closed repeaters to the detriment of normal amateur operation. Yes, there is a place for closed repeaters, but not at the expense of general amateur operations. Think about it, then act.

The 2m Quad Project

Here's a great antenna project for your club!

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As the rainy season blew into Puget Sound, I was giving thought to the second semester of our electronics technology program at Sno-Isle Skills Center. During this semester I teach amateur radio to my junior and senior high school students ... a daily block of three hours of classroom lecture and lab. Each of my students builds an AM/FM superheterodyne receiver to give further understanding to my lectures on electronics theory. This gives these teenage intellects a break from the 30 minutes of dits and dahs of Mr. Morse's code.

December brought rain, rain and, when the sun was about to appear, more rain. January was just a little bit more of December: rain, rain and wind. What does this have to do with young high school students and amateur radio? A reason to demonstrate antenna theory in the classroom, and hope for sun in February—to be exact, on Groundhog Day. On February 2nd the sun did peek out to greet my birthday. Having spent over nine-tenths of my life as a ham radio operator, I felt that this was an appropriate time to take the class outside to test the antennas we'd made in the classroom.

"The rationale for using oxyacetylene welding wire for the elements was to keep the cost of our quad to $0, and also to improve the students' soldering skills."

We'd made a half-wave dipole for 2 meters, 146.58 MHz, using the formula 468 divided by the frequency in MHz for a length of 38.5 inches. Devin Corbett KB7NKT cut the number 12 wire and installed a PIN diode and a Fluke 87 Digital Multimeter in series with the antenna to measure the current. Two meters gave us the compact size and also allowed me to demonstrate vertical and horizontal polarization.

Photo A. Devin Corbett KB7NKT and Matt Chapsin checking the SWR.

As I explained the half-wave dipole antenna to my students, their eyes began to glaze: "Like how can this work?" With our demonstration, some of these bright young minds opened up and started to ask questions: "How can a full wave fit into a half-wave length of wire?" My excitement increased with each question. I found *The ARRL Antenna Book* and started to look for a 2 meter quad antenna that we could make with little cost to the students.

Sno-Isle Skills Center is a vocational high school with 22 programs of instruction, from automotive technology to welding. The resources of the faculty and supplies are a ham's dream come true.

During the last week of January, it rained some more. This was an opportune time to build a single-element quad at home to illustrate a full-wave antenna to the students. The third quarter of instruction is communication electronics and the goal of each student is to pass the Technician Plus exam. The half-wave dipole and quad are both antennas that are covered in the exams. In my lectures on antennas the students calculated the length of each type of antenna needed to pass the exams. For quads, the length of the full-wave loop can be calculated by 1005 divided by the frequency in MHz. If multiple elements are used, the reflector should be five percent

longer and the director(s) five percent shorter.

With my *Antenna Book* in hand, I went to the faculty lounge to discuss my quad antenna project with some of the staff. I showed Dan Minzel, our welding instructor, the drawings of a portable 144 MHz four-element quad. He had a large quantity of 1/8-inch diameter oxyacetylene welding wire that we could use for the loops. Al Urness N7QDC, our plastics instructor, had the PVC support (spreaders) and a Fiberglas™ boom. The machine trades instructor, Tom Clemans, suggested he have his students drill all of the holes needed in the PVC (spreaders) supports and boom. It's as exciting to have cooperative working groups on the staff as it is to teach in the classroom. It was a good beginning to the second semester.

"The resources of the faculty and supplies at Sno-Isle Skills Center, a vocational high school, are a ham's dream come true."

The element spacing for quad antennas found in literature ranges from 0.14 to 0.25. Factors such as the number of elements in the array and the parameters to be optimized (F/B ratio, forward gain bandwidth, etc.) determine the optimum element spacing within this range. The four-element quad we constructed in class was cut for 146.58 kHz. We decided on a reflector length of 86 inches, with the driven element 81 inches and the directors 77 inches long.

Construction

We began with the 10 feet of 1/2-inch PVC for the booms that was provided by Al. It was cut to 42 inches in length, with allowances given for the two PVC tees, one for the reflector and one for the first director.

The reflector tee was glued to one end of the boom, 16 inches from the center of the driven element tee. This was the work of another classroom team led by Matt Watson. Matt made sure that the distance from the center of the reflector tee was 16 inches to the center of the driven element tee, and the second director tee was on center, 13 inches from the driven element. Finally, the first director measured 13 inches from the second, then all of the PVC tees were glued into place.

Construction of our first four-element quad began with 1/2-inch PVC spreaders. These elements were first assembled with the holes drilled for the 1/8-inch brazing rods. The reflector spreader was 22-1/2 inches long, with 1/8-inch holes drilled 10-3/4 inches from the center of the boom. The driven spreader was 21-1/4 inches long, with holes drilled 10-1/8 inches from the center of the boom, and the directors were 20-1/4 inches, with holes drilled 9-5/8 inches from the center of the boom.

We used 1/2-inch PVC for the boom with PVC tees to install the spreaders; each spreader was cut in half, i.e. the reflector was cut at 11-1/4 inches, then each end was glued to the tee and in turn to the boom.

The rationale for using oxyacetylene welding wire for the elements was to keep the cost of our quad to $0, and also to improve the students' soldering skills. No. 8 aluminum ground wire will work just as well. The brazing rods cost around $2.26.

A 12-inch x 2-inch Plexiglas™ plate was used to support the feed point hardware and the feedline. The feed point support was epoxied to the boom. Using a heat gun, we bent the Plexiglas to meet the driven element. The ends of the brazing rods were 3/4 inch apart where they mounted on the Plexiglas plate. We left enough excess rod to bend a small loop for attachment to the coaxial feedline with stainless steel hardware.

For vertical polarization, we located the feed point in the center of one side of the driven element. In tests, we found that there was a 10 dB loss in the horizontal polarization when we tested with a local repeater.

We connected the coax to the bolts connected on the driven element support plate, and ran the RG-8 along the Plexiglas to the boom. From there the cable was routed directly to the mast and down. The antenna provided very good performance, with a reasonable SWR over the entire 144 MHz band. We used a Bird wattmeter to measure the reflected power and found that with 100 watts out, less than 1/2 watt was reflected.

The kids now know what a full-wave antenna is, compared to a half-wave antenna. Our next classroom project is to build a PVC 10 meter quad. We'll be looking for you on 10 meters.

Photo B. Devin Corbett KB7NKT measuring the spacing for the feedline.

Life After Your No-Code Tech License and Handheld

Without having to know CW.

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Now that you have your No-Code Technician's license, you've bought a 2m handheld, mounted it in your car for mobile use, even put up a good vertical antenna on your chimney, and bought or built a 13.8V power supply to get the handie's "full gallon" out ... *great, welcome to the hobby!* Now where do you go from here? There are several modes, other than FM repeaters, that will let you talk to a wider world.

With repeaters, you can get out a reasonable distance, but with a better antenna and more power (30-150+ watts) you can do even better on the FM simplex frequencies. Add a linear amplifier (with a receive preamp) to your handheld and a modest beam antenna mounted 10 feet or more above your roof line, and you are in business. Contacts up to 100 miles are routine (including distant repeaters), but when the band opens up, look out! Contacts of up to 500 miles are common. All of this assumes you do not live in a hole; if you live in a valley with a 100-foot+ ridge within a quarter mile, you should consider moving, learning CW and going HF, or going to satellite operation.

> ***"Welcome to the hobby! Now where do you go from here?"***

Vertically polarized FM signals do not travel as well as horizontally polarized SSB signals. This world requires multimode transceivers, which are more expensive because they do everything your handheld will do, but add SSB and CW modes, more power, and more features. There is a lot of activity in both modes on the 2 and 6 meter bands, with a bit less on 70 cm. Let's stick with 2 meters for now because you will likely want to use FM to check into nets and use repeaters—so keep your vertical antenna.

Transceivers

What is available? Unfortunately, not much on the used market. Rigs occasionally become available, but sell quickly. Most older rigs seem to have been good, but avoid radios that are more than eight years old if you want to work satellite (they aren't designed for the required talking and tuning). In the current market, the basic multimode is the Yaesu FT-290RII. It puts out 25 watts, is small, and can be used as a base, mobile or fat handheld. The new Kenwood TM-255 can be either a mobile or base, puts out 40 watts, has many more features, and costs more—but it's worth the extra money. Both these rigs can be enhanced with a linear amplifier that will boost the output to 150-170 watts. It is best to get one with a GaAsFET receive preamp for weaker signals. They cost about $280 and require a minimum of a 35 amp power supply. Next, there is the ICOM IC-275H base station running 100 watts. It requires a 12V, 20A power supply. The IC-275H costs more than the Yaesu and Kenwood models, but it is required if you want to drive a full-legal-limit linear. Finally, there are multiband base stations that start at $1,700 and go up as you add bands and options. The extra investment may be worth it if you want to work 2 meters and 70 cm or 1.2G (one radio will do four bands) and all satellite modes.

Towers, antennas, and feedlines

It helps to have a good antenna, but it helps even more to get it up as high as you can and feed it with the best coax you can afford. Since VHF antennas are small and light, TV towers or mounts are more than adequate. Used TV towers are relatively cheap and easy to install. If you live in a two- or three-story house with a high-pitched roof on high ground, then a rooftop tripod mount will do just as well.

Use RG-8 or better coax for runs up to 50 feet, and RG-9913 or 9914 for longer runs. Hard-line or heliax is ideal if you can get it cheaply, but be careful to examine used hard-line very carefully for any previous kinks or water penetration.

You will need a rotor and, again, a TV rotor is all you need. Used ones are all right but I prefer new ones with good seals to prevent freeze-up if you experience that type of weather.

If you enjoy building things, then it is easy to build your own antenna. The simplest antenna is a cubical quad, but feed the coax at the bottom for SSB and at the side for FM. This antenna can be made from common building materials such as wood, ABS, PVC, CPVC, aluminum wire, copper wire, or brazing rod. Plans are readily available and easily adaptable to the materials you are comfortable working with. Just be sure you build it well; most plans I've seen are rather flimsy designs that are not suited to Canadian or Minnesota winters. If you got a used TV antenna with your used tower, or you otherwise find used TV/FM antennas, they are an excellent source of material for a yagi antenna (*73*, September 1993). To improve gain, stack two yagi antennas for an extra 3 dB. To achieve the same increase in gain you have to double the boom length, which creates major mechanical and wind load

problems. A VHF SWR meter (MFJ-812B or equivalent costs about $30) is a must-have to tune your antenna.

If you are not a builder, an eight- to 13-element commercial yagi will work just as well. Get one that is optimized for the 144-146 MHz part of the band (that's where the SSB/CW activity is).

RS-10 and RS-15

These are Russian amateur satellites that are relatively easy to use because they are in low circular orbits. If you started as an SWL and have a good tabletop communications receiver that handles SSB, then you are in business. You will also need a computer and some tracking software to tell you when the satellites are overhead. These satellites receive SSB or CW on 2 meters, then return the signals on the 10 meter band; look at them as a fast-moving repeater in the sky, with a big offset. You should listen to them on 29.352-29.405 MHz USB first because you may be in a high-noise area and because they are low power; local noise levels may overpower their signal.

A homemade quarter-wave vertical or turnstile 2 meter antenna (25-100W) and a 10 meter inverted Vee antenna with a 10 meter preamp both work great. With the satellite in the right position you can talk to all four coasts. The newer RS-15 satellite is in a higher orbit with even better coverage (into western Europe and northwest Africa from eastern N.A. and Central/South America). If you do not have a good SW receiver, used Radio Shack™ HTX-100 10 meter transceivers sell for $100-125 (or less if it has a blown transmitter). For an additional investment of $30-200 you can cover three continents and Hawaii.

Other birds

There are a number of other amateur satellites available that are in higher elliptical orbits. They also have a different set of transponders, operating in the 144 and 430 MHz bands. Because of their higher orbits they have much better coverage (sometimes halfway around the world). To work them requires a dual-band multimode transceiver and a special antenna and rotor system for tracking.

"If you have a big back yard, very understanding neighbors, very deep pockets, and considerable technical skills, then bouncing signals off the moon can be a real challenge."

6 meters

Depending on conditions, this band can be either a VHF band or an HF band without much of the noise associated with HF. Contacts of 250 miles are routine, but when this band opens up it is spectacular. Contacts into Central and South America, and occasionally Europe, are possible. Since 6 meter antennas are larger, TV towers become marginal unless they are well guyed. Likewise, TV rotors are not adequate for larger (four- to six-element) boom antennas: medium duty rotors are recommended, or required if you add your 2 meter beam to the mast.

Moonbounce

If you have a big back yard, understanding neighbors, very deep pockets, and considerable technical skills, then bouncing signals off the moon can be a real challenge. Eight 17-element yagis, a precise two-axis rotor system, a computer to control it, a full-legal-limit linear, a super-low-noise preamp, and a good transceiver are all you need. It would also help to be single or have a wife who is a ham and shares this interest. With this mode, I have violated the subtitle of this article—moonbounce activity is almost entirely CW, but 5 wpm is enough.

Survey of VHF/UHF Radios

The following list is by no means comprehensive but is intended as a beginner's guide to the marketplace. Detailed specifications can be obtained from the manufacturers or your favorite ham radio emporium. Prices quoted are from my favorite U.S. discount chain. Your dealer may sell for less but ask them why if they do not.

Single-Band Multimode Radios:

- Yaesu FT-290RII 2 meter mobile—$630; 25W. Basic FM radio with SSB/CW added, few features and not suited for satellite or CW operation.
- Kenwood TM-255 2 meter base/mobile—$900; 40W. Full-featured "state-of-the-art" FM/SSB/CW transceiver.
- ICOM IC-275H 2 meter base—$1,700; 100W. Full-featured FM/SSB/CW transceiver, recently reduced in price.
- Kenwood TS-60S 6 meter base/mobile—$990; 90W. If you want to go 6 meters, this is the radio.
- MFJ-9406X 6M SSB/CW base—$260; 10W. Excellent starter radio; add a linear as budget allows.

Used 2 Meter Radios:

- Kenwood TR-751A—A not-so-old goodie. They sell quickly; be first in line at the hamfests. $400-600.
- Kenwood TR-9000—An oldie, but perhaps not so good any more. 10W (or 30W on TR-9130). Unsuitable for satellite operation. Good starter radio for about $200, or $250 for the 9130.

Multiband (2 Meter and 70 cm) Radios:

- ICOM IC-820H—ICOM's newest, but 2 meter and 70 cm only. $1,700; 30W-45W. Full-featured for terrestrial and satellite.
- ICOM IC-970H—ICOM's best. $3,900; 30W-45W; 1.2 GHz optional. Overpriced compared to others.
- Kenwood TS-790A—$1,770, 30-45W; 1.2 GHz optional.
- Yaesu FT-736R—$1,830; 25W. Can add two more bands from 50 MHz to 1.2 GHz for great flexibility.

Amplifiers:

Any radio with less than 50W should have a matching linear amplifier. Manufacturers are: Henry or Command Technologies for kilowatt units, and Mirage, RF Concepts, RF Technologies and TE Systems for 100W-300W units.

QRP

Low Power Operation

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Operating QRP usually means you're going to be using CW. Building a transmitter for CW is a lot easier than hacking one out for SSB. So, it's easy to see why there are many add-on devices to improve the sending of CW, but there's very little on the market for the phone operator. Voice memory keyers have been expensive for the once-in-awhile QRP phone operator—until now.

"Voice memory keyers have been expensive for the once-in-awhile QRP phone operator—until now."

The ChipCorder

Killing some time at a local Radio Shack™ store, I came upon a small blister package containing the VM-1110A voice record and playback module. The VM-1110A is a self-contained solid–state voice module that will hold up to 10 seconds of audio. The entire VM-1110A is housed on a preassembled PC board about the size of a postage stamp (see **Photo A**). There are about a dozen surface mount components on the board, while the actual ChipCorder is just a blob of epoxy on the circuit board.

The circuit board is fitted to go inside an edge-card connector, or to be plugged into the PC board with the supplied dual-pin header.

A closer look

The VM-1110A contains everything you need to record and play back audio. All you need to add are some switches and an electret microphone. The VM-1110A has a built-in audio preamplifier, automatic gain control, and an anti-aliasing filter on board. There's even an audio power amplifier on the board that will drive a speaker directly. But perhaps the best part of the VM-1110A is the price—it's only $15! The Radio Shack stock number is 276-1324.

Another feature of the VM-1110A is the automatic power-down mode to drop current to .5 µA. It will operate on a single +5 volt supply, and the message storage retention uses zero power. After I've been laid out on that cold marble slab, the VM-1110A will still keep my "CQ CQ QRP..." in memory for at least 100 years!

Making the VM-1110A talk

You'll need a +5 volt supply at 35 mA to run the VM-1110A. A 78L05 will work, just be sure you bypass the input and output leads of this regulator with some .1 capacitors.

You can also use a set of four AA batteries with an 1N4002 diode in series to drop the voltage down to .5 volts. If you use the batteries, there is no need to use the regulator. Be careful to put the correct polarity to the VM-1110A as it will most certainly be damaged by reverse voltage polarity.

You'll also need an electret microphone; Radio Shack #270-090 is the one of choice. Also, a couple of push–button switches will be required for the start/record and playback function.

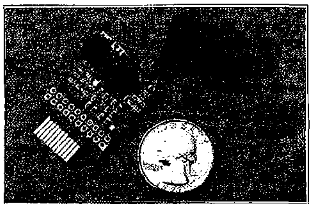

Photo A. The entire VM–1110A is housed on a preassembled PC board about the size of a postage stamp.

There's not much to do—you hook up the switches to the correct pins and connect the microphone, apply power, then begin recording. You can make up to a single 10-second recording. At first that does not sound like a lot of run time, but in real life, 10 seconds is rather long! Most dyed-in-the-wool DXers can work six contacts within a 10-second period.

Recording

To record a message, a low-going transition on the REC line initiates a new record operation from the beginning of the memory, or at a selected location, regardless of any current operation in progress. You do not need to fill the entire memory. Releasing the REC signal HIGH before filling the message spaces causes the recording to stop and an "end of message marker" to be placed. The device then powers down and goes to sleep.

You can place an LED on the RECLED output pin to provide an active low signal which can be used to drive the LED as a "record in progress" indicator. The module has a 1k current-limiting resistor already on the board to limit current to the LED.

Playback

Pulling PLAYE or PLAYL signal LOW initiates a playback cycle. This cycle is then completed when the end of message marker is encountered. Playback then ceases and the device goes to sleep.

Interfacing the VM-1110A into the rig

I coupled some of the audio output from the VM-1110A directly into the microphone jack of my Argonaut II. It seemed to work just fine after I played with the gain and drive controls.

A much better approach would be to use an op amp as a simple microphone mixer and adjust the mixer to match the audio level of the external microphone. This way, the audio level from either the VM-1110A or the microphone would be the same.

Odds and ends

I guess it would be possible to use one of the level active pins and link two or more VM-1110A modules together to provide longer record and playback times. Any one want to give that a try?

As a club project, a single circuit board could be assembled to hold a VM-1110A and the required switches and power supply. You could record and then remove the VM-1110A to use at a remote location.

"For the ultimate bell and whistle, how about a programmed VM-1110A triggered by an SWR sensor to alert you to a problem with your antenna system?"

The VM-1110A is cheap enough to allow you to record one module with a CQ and then a second or third module to hold reports or "QRZs..."

And for the ultimate bell and whistle, how about a programmed VM-1110A triggered by an SWR sensor to alert you to a problem with your antenna system?

All in all, the VM-1110A is a whale of a lot of fun. There's not much in life that's this much fun (legally, anyway) for under twenty bucks. Pick up one of the VM-1110As from Radio Shack and shoot a Saturday evening.

Number 49 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
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He rides the airwaves

Now that I'm in the process of packing away many of my wall displays of QSL cards and trying to fit the school term's collection of papers and books into cartons for the summer, I promise myself to throw away outdated materials that I can no longer use. Being a collector by nature, this is no easy task. I subscribe to the philosophy of "sooner or later every scrap will have some use."

Since I am rapidly growing out of classroom space and storage area, I must start separating my materials before I pack them away. One textbook that definitely goes into the "to save" pile is *Ride The Airwaves With Alpha & Zulu*, written by John Abbott K6YB. If you're looking for a new resource to put into your classroom or clubhouse library, you should consider this book.

John Abbott K6YB

First, let me tell you a little about John. His class and mine made several really terrific radio contacts a few years ago. He has been teaching ham radio class, a requirement for gifted students at Los Feliz Elementary School in Hollywood, California, since January 1990. Then a communications engineer for the Los Angeles City Department of Water and Power, he had joined a DWP program in which engineers did volunteer work with students one day a week. He chose Los Feliz Elementary at the suggestion of his wife, Teri, who teaches third and fourth grades there.

He retired in 1992 and now holds classes twice a week. "My wife told me the kids needed something like this as an outlet," says John, a ham radio devotee since he was 13. "Most of the kids live in little apartments. This lets them know there's another side of life out there."

According to a newspaper article John sent me, his students have spoken with people in Mexico, Central and South America, and as far away as New Zealand and Japan. They communicated with the space shuttle in 1993 and received printouts from NASA's MARS observation satellite observing Mars.

School principal Betty Castaneda estimates that John's contributions would cost the Los Angeles Unified School District about $30,000 a year if he were paid. That's not even mentioning the equipment he's donated—about $5,000 worth. She says, "There are four or five other schools in our district that have a ham radio class, but they don't have a real engineer to teach them, and they're not as diversified.

"The most important thing John does is provide a role model," she says. "He's comfortable around the technology, so the kids are too. Also, more than half the kids do not have fathers—they come from single-parent homes—so he's a father role model as well."

As for the kids: "It's fun," says 10-year-old Gerardo Arturo Estrada. "You get to meet a lot of people and make friends."

John sees another appeal, the one that hooked him as a teenager: "Here you are in your little world, and all of a sudden you can get on the air and talk to anybody in the world," he says. "It's that feeling that you're riding the airwaves. You're bouncing around the world; your voice is going through space and time forever."

"School principal Betty Castaneda estimates that John's contributions would cost the Los Angeles Unified School District about $30,000 a year if he were paid, and that doesn't even include the equipment he's donated—about $5,000 worth."

The newest *Ride The Airwaves*

The 1996 edition of *Ride The Airwaves With Alpha & Zulu* is an improvement over the 1993 version. There are now 59 characters instead of 16—all 43 characters required by the Element 1A code test, plus 16 binary characters. In addition, a "space" theme has been incorporated. This delightful soft-cover book uses comic book characters, The "Phoneticos," to prepare students to take two different amateur radio exams, the Novice and the No-Code Tech. If you look closely at the Phonetico characters you will notice that each of their bodies is made up of the Morse code "Dits" and "Dahs" that form the correct symbol for that character's letter.

After each cartoon page there is a testing page. The answers to the quiz are found on the bottom of the following page. There are crossword puzzles and games throughout the book. The children in my sixth-, seventh-, and eighth-grade ham radio classes always enjoy the lessons I do based on material from John Abbott's book. For more information or to purchase a copy of the book (single copy: $14.95), contact John at ABTRONIX, P.O. Box 220066, Newhall CA 91322, (805) 222-7384.

Well, there's no need to continue the throwing out process today. I'll pick up where I left off tomorrow. Of course, if I keep on discovering books like John's that I enjoy so much, not too many items will be thrown away. What I really need is a suite of rooms, not just a classroom, for all my wonderful ham radio materials. Have a great summer!

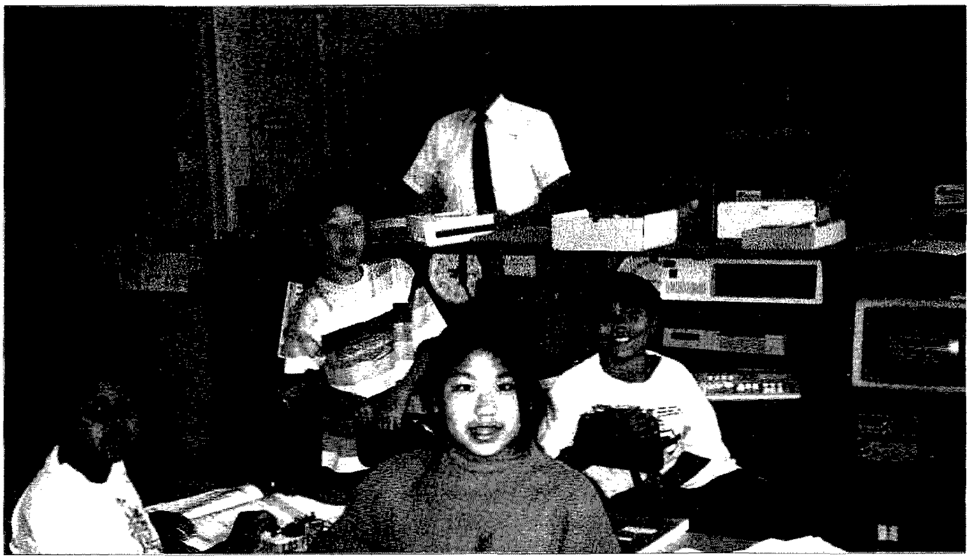

Photo A. John Abbott K6YB (rear) with Joyin and Jimmy (back row), and Gerry and Suzan (front row). Joyin is from Korea, Jimmy and Suzan are from Thailand and Gerry is from Mexico.

Number 50 on your Feedback card

Ham to ham

Your Input Welcome Here

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This month's column contains quite a bit of good information, so let's get right to it. Suffice it to say that I'm always interested in any ideas from readers, such as the ones below, that have practical amateur radio applications. So get out your pens, word processors or parchment and quills, and keep them coming this way. My address is at the top of this page. All contributions will be promptly acknowledged; I'm also usually able to give you a rough idea of when your tip will appear if it's accepted.

On the "light"er side

In last month's column, I suggested using one of the new "laser pointers,"for "seeing-through" a printed circuit board so that a component located on the top side of the board could be easily identified for unsoldering on the bottom side.

In addition to the laser pointer, a small Mini-Mag® light, one with a beam that's able to be focused down to a small "spot," can be used to highlight the area of interest. It's not as dead-on-accurate as a laser pointer, and it only works on PC boards that are translucent—the room must be fairly dark—but it does work nicely on most phenolic boards encountered in ham radio equipment. Sometimes you can even see the silk-screened printing from the other side coming through, though of course it's reversed.

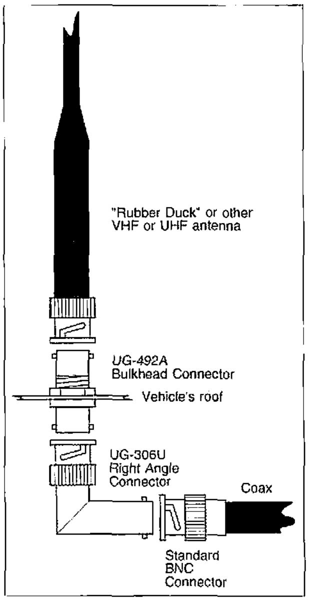

Fig. 1. NZ9E's tip for inexpensively mounting a VHF or UHF mobile antenna on a vehicle's roof.

So if a laser pointer is still not on your workbench (they're down to less than $30 now), a small mag flashlight should be, and it can be used in a similar way. Now all you need do is to hunt down the component that needs replacing! Some of the other tips we have this month may help in that area.

Put the heat on 'em!

To make the removal of self-adhesive labels or escutcheon plates on equipment much easier, try using a heat gun to pre-soften the sticky adhesive backing first. I recently wanted to repaint the top and bottom covers of a used ham transceiver I'd bought. Using a shrink-tubing heat gun to soften the backing on the covers' labels allowed me to neatly remove them without a trace of damage, something that would not have been the case had I tried to remove them "cold." The heat supplied by the shrink-tubing heat gun (or perhaps a directable hair blow dryer) was just enough to loosen the backing so I could slip a single-edge razor blade under the escutcheon label and pry it up. (To reinstall the escutcheon labels after painting the covers, I used Scotch™ #136 Double Stick Tape; it's available at stationery supply stores.) Just be very careful about how much heat is applied to plastic or other surfaces that may be damaged by too much of a good thing. Generally, if the right amount of heat is used, self-adhesive labels will release easily, and can be removed without leaving a gummy residue behind—or at least leave only a minimal amount. Give it a try.

Goo Gone

If my tip on softening labels with a heat gun (above) comes too late, the goo left behind by unsuccessful prior removal can often be cleaned up with a product called Goo Gone®! Really, that's its name! Actually, I have to respect products that state what they do right up front. Goo Gone is made by Magic American Corp. of Cleveland, Ohio 44122. Its maker claims that it's effective in removing residue left behind by tape and other adhesives, as well as oil, gum, tar, scuff marks, polish, wax, grease and many other remnants. It has a pleasant citrus smell and comes as a thin, gold-colored liquid in several container sizes. It can usually be found in hardware stores and home centers. I bought mine at a railroad hobby show, since it's also popular for cleaning model railroad engines and track.

As with any cleaning product, always test a small spot first to check for any adverse chemical reactions, especially on painted surfaces and plastics. There are so many chemical formulations today that it's virtually impossible to make an effective cleaner totally compatible with all of the possible synthetic combinations.

Easy does it!

Here's an idea that I've used several times to give me an inexpensive, option-filled mounting scheme for mobile antennas on my own cars (see **Fig. 1**). It lets me swap antennas at will, as well as remove the radiating element very quickly for automatic car washes, etc., replacing it with a BNC dummy plug instead.

The idea requires drilling a single hole, large enough to pass the mounting threads of the UG-492A bulkhead connector, so if drilling a hole in your car's roof or trunk lid is completely out of the question, read no further. Personally, I'm not averse to the idea since it provides a low-profile mounting arrangement, with a good connection to the surrounding ground plane (the car's metal roof).

The quick exchange of antennas is also very nice, allowing me to use anything from a 2 meter rubber ducky to a 19" whip mounted in a BNC connector, to a 5/8-wave-gain whip antenna...all with a twist of the wrist! Though I've only used this combination on 2 meters, it should work equally well on 1-1/4 meters and 70 cm. It's as strong as the roof of your car, so even a fairly robust 2 meter gain antenna is usable with it. If, however, too much roof flexing occurs, a steel backup plate with a clearance hole drilled in its center should solve the problem easily. When it comes time to sell the car, you can simply leave the BNC bulkhead connector jutting out, or use a small hole-plug to make it even less objectionable...but that's probably the least of the items that the buyer will be concerned about when it comes to your car's value.

Be sure that whatever brand of rubber ducky you use will handle the power output of your mobile radio. Some of these flexible rubber-coated antennas are only rated for a few watts and will become noticeably warm to the touch when any more power than that is applied to them. It's easy enough to test—just place your palm around the antenna's body after 30 seconds or so of FM transmit time; if it feels too warm, use lower power or a different antenna.

Color-wise

From William Thim, Jr. N1QVQ: If anyone is planning on home-brewing an outdoor antenna, and those plans include the use of PVC non-conductive pipe, here's a caveat. Although you may feel that white PVC piping may be better for aesthetic reasons, white may not be the best choice for longevity. White PVC out-of-doors will yellow, lose its plasticizer, become brittle and eventually crack upon prolonged exposure to the elements and ultraviolet rays. So for most amateur antenna work, black is probably the better choice.

Black PVC pipe is embedded with carbon and holds up outside considerably better than its white counterpart. There is also a clear PVC pipe not generally available

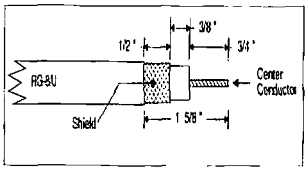

Fig. 2. Stripping dimensions for an RG-8/U cable, using the method of attachment described in WB9YBM's text.

to the public, but it's impossible to guess how the clear variety will weather until it's been in general use for a while. Perhaps other readers may be able to offer more input.

I've used a couple of sections of the white variety of PVC pipe outside on my own antennas, though I don't have any long-term experience with its durability. Bill's point is a good one, and I did paint the pieces I'm using, for the very reason he gave: ultraviolet exposure protection. Painting should help. The black PVC pipe Bill mentioned doesn't seem to be found as easily in home centers in this area of the country, so my use of painted white was pretty much forced upon me. Lacquer spray and oil-based paints seem to hold a bit better to the non-porous PVC surface. Latex appears to be the worst for good adhesion properties on this material, although it does "give" more with any pipe flexing.

Neatness counts

From Klaus Wolter N8NXF: Teflon™-insulated wire is great for repairing damaged foil traces on the bottoms of printed circuit boards, as well as for point-to-point bus wiring, due to its non-melting characteristics, even when subjected to direct contact with a hot soldering iron. Unfortunately, it's not at all easy to strip, especially in cramped quarters! As a result, I've been making my own Teflon bus wires using #24 tinned solid copper wire and hollow Teflon tubing.

I cut off a piece of bus wire a little longer than I think I'll be needing, then stretch it to get it nice and straight by pulling it through my fingers a couple of times. After straightening it, I slip on a length of Teflon tubing—also a bit longer than I think I'll need—and solder one end of the wire to the first connection point. Now, laying out the wire/tubing combination along the path I want the bus wire to take, I slip the tubing right up to the soldered connection point and grip it firmly with diagonal cutters at the other end, where it will end. I then slide the tubing back out past the end of the wire a bit and clip it off. When it's pushed back on again, it will be a perfect fit and the free wire end can now be cut and soldered in place. No tugging, no stripping woes, and it's immune to any molten solder drops and hot irons.

Here's another quick tip you might try if you don't have any lacing cord or cable ties handy: Waxed dental floss makes a tough, space-saving lacing twine substitute to hold groupings of wires together in today's compact radios. You do have dental floss, don't you?

Clamp down on PL-259s

From Klaus Spies WB9YBM: Adapters are readily available for attaching RG-58 and RG-59 diameters of coaxial cabling to a PL-259 connector, but there is nothing similar for attaching the thicker RG-8 diameter cables to that fitting.

Most references suggest that you solder the shield of the RG-8/U coax to the body of the PL-259 (through those little holes on the connector's body, just past the outer shell mating threads), but that requires a great deal of heat and carries with it the possibility of damaging the insulation because of that excessive heating. Well, here's a way to attach RG-8 diameter cables to a PL-259 securely without having to apply any heat at all to the coax's shield conductor, and it makes a reliable,

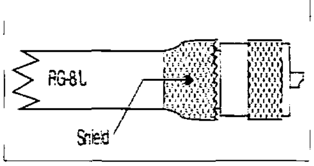

Fig. 3. The shield of the RG-8/U cable is shown fanned in place over the connector's rear sleeve area. See text for complete details.

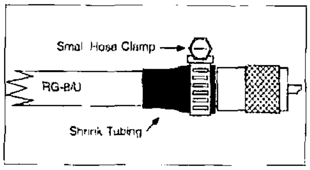

Fig. 4. WB9YBM's completed termination, shown with the stainless steel hose clamp in place over the connector's rear sleeve area.

weather resistant connection in the process.

Fig. 2 shows the stripping dimensions to prepare the RG-8 cable for attachment. Prior to stripping the cable, slip a piece of 5/8" inside diameter heat-shrink tubing and a small stainless steel hose clamp onto the cable's end. Tin the center conductor, screw the outer shell and body of the connector together, slip it onto the cable, then solder the inner conductor securely. Next, fan the shield forward over the rear sleeve area of the body, as shown in **Fig. 3.** Now slip the shrink tubing forward over the fanned-out shield wires, and shrink it down nice and tightly using a hot air gun. The process is completed by sliding the stainless steel hose clamp up and over the tubing and the rear sleeve area of the connector and tightening it down securely, as depicted in **Fig. 4.** I've used a Tridon™ 300-SS clamp successfully, which is about 5/8" inside diameter when fully loosened (but not quite parted). These and other brands of clamps are readily available at automotive supply or general hardware stores. Bring a PL-259 connector along with you if you're not sure of the exact size needed.

That's it; you're done. You now have a mechanically tight, electrically sound PL-259 on a length of RG-8/U or similar diameter cable. For use outdoors, you must still waterproof the entire fitting using layered electrical tape, self-bonding tape, coax cable sealant putty, or whatever method of total sealing you prefer. Water should never be allowed to enter into the coax cable's shielding; this method of attachment helps to assure that this won't happen because of the shrink tubing addition. Should you ever want to salvage the connector in the future, the fact that the shield and surrounding insulation isn't "melted" into the inside of the PL-259 body will make reuse a snap. As far as the soundness of the shield's contact with the connector's body is concerned, I've not had one of these fail me—inside or outside—in a number of years of use. After all, the shield isn't soldered to the mating SO-239 connector either, but, obviously, mechanical tightness is important for long-term trouble-free service.

Dirt cheap test gear

From Michael Fratus: A working, inexpensive, portable AM/FM broadcast band radio can often be used as a substitute for more costly test gear when building, testing, or repairing ham equipment. Used with its internal 9 volt battery, the portable BC band radio can prove to be the safest and most versatile choice at times.

The AM band oscillator, for example, can be utilized as a signal source for a 1 MHz to 2 MHz CW signal when troubleshooting or signal injecting. This signal can be tapped from the AM tuning capacitor, via a 100 pF disc capacitor, and brought out for injection into the ham receiver under test. The AM oscillator can be modified to generate a slightly different range by adjusting or removing the coil's tuning slug, or by varying the number of turns on the coil itself through experimentation.

The 455 kHz AM band IF circuit can be coupled, via a 100 pF disc cap, to the ham receiver under test for checking either the 455 kHz conversion circuitry (by feeding the ham receiver's signal into the AM portable's known-to-be-good IF chain) or for injection into the ham receiver (by feeding the AM IF signal into the ham receiver's IF chain).

The FM portion of the portable receiver can offer the same options—checking the 10.7 MHz conversion stage or for feeding a 10.7 MHz known IF signal back into the ham receiver via a 10 pF disc cap. The FM oscillator can also be used as a signal source, from 98 MHz to 118 MHz, coupled via a 10 pF or so disc cap,

and the basic oscillator frequency range can be easily changed by spreading or compressing turns on the oscillator coil itself or by winding a completely new coil.

The audio section of the portable can be tapped, via a .1 μF or higher non-polarized coupling cap, to the center lug on the volume control. Again, audio can either be fed into the portable or injected from the portable into the ham band receiver. Higher level audio, of course, is available at the above-ground speaker terminal.

I usually start by finding all of these points on the portable's circuit board, attach the appropriate capacitor, then bring the cap's lead out via a small hole drilled in the plastic case. A loop on the outside end of the capacitor's lead makes a nice point for gripping with an alligator clip. Don't forget to bring out an insulated wire from the circuit board's ground and to mark all of the "tap" points for easy identification later on.

Excessive voltages can sometimes destroy one of these small portable radios, but even if you do damage it at some point, you can replace it for a couple of dollars at the next hamfest!

Switch to manual(s)

From Peter Albright AA2AD: Servicing, at almost any level, is made much easier by having the published service data for the specific piece of gear in question at your fingertips. While many problems can be located and rectified without the service literature, just having the schematic diagram can provide a quantum leap in servicing efficiency. Perhaps because of ham radio's more technical nature, ham equipment manufacturers have traditionally been more likely to include at least some service information (albeit, perhaps just a schematic diagram) along with their operating manual, but some are no longer doing even that.

Full-blown service manuals are available from the manufacturer for most ham transceivers, and they are a good investment if you intend to do any repair work yourself. The service manual often contains an informative "how-it-works" section, in addition to the schematics, PC board layouts, parts listings and setup, and adjustment procedures. Even if you never use the service manual yourself, you can often recoup its investment when you later sell the rig! Many "ham friend" service techs won't go very deeply into your radio without the aid of a service manual (equipment today is just too complicated to risk it) so servicing information will often be required by independent technicians. It's a good idea to procure a service manual for your new transceiver as soon as you can, since as time goes on they often become harder to find.

One source for older service manuals (if the manufacturer tells you that he no longer stocks it) may be Howard W. Sams Company in Indianapolis (Tel: 215-725-6722).Though often associated more with consumer electronic servicing information, Sams does have a photocopy service information index that lists many ham radio transceivers and accessories, so they're worth checking with before you give up completely.

Some ham equipment dealers also stock service manuals and a few quick calls to them can be rewarding. The ham VHF/UHF packet network is also a possibility. If you don't have packet access yourself, a ham friend who does can put out a "WANT @ ALLUSA" bulletin for the manual you're looking for (we see them every day). Don't forget to mention that you're more than willing to pay all associated expenses for obtaining the copy that you need, and provide your home phone number for the quickest response. Some voice repeater nets have a "Swap & Shop" segment in their net-night gatherings, and putting out a "wanted" request there might be worthwhile at times. *73* also has a want-to-find public service column called "Ham Help" that can be effective after you've exhausted the other avenues.

Servicing information is worth its weight in gold when you need it, so play it smart and don't put it off until the last minute, when your station is down because of an inoperative key piece of gear.

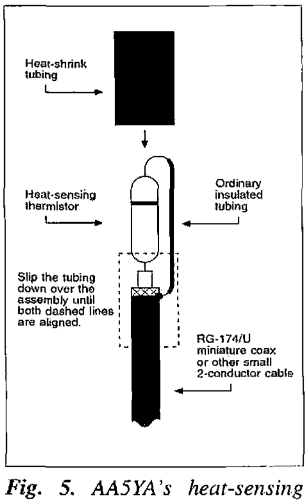

Fig. 5. AA5YA's heat-sensing thermistor's wiring details. See text for complete description.

Free mountings

From Joel Masur AA5YA: If you need to mount a thermistor on a chassis or heat sink to signal a cooling fan or other circuit when to turn on, try this inexpensive method.

If you know someone who works with the power company, or you can make friends with one of their linemen, the blown "in-line disconnect switch" fuses that they use can be disassembled and the threaded end-cap recycled as a rugged mounting for an in-line, pigtail thermistor mount. These "in-line disconnect switches" have a door that's spring-loaded and drops down whenever the pole service fuse blows (it sounds like an M-80 firecracker going off!). The parts I'll describe are the throw-away end caps. They're already threaded for 1/4-28 MS, so only a 1/4" hole needs to be drilled into the body of the cap. Then, using a glass-encapsulated thermistor (about the size of a 1/8 watt resistor) such as the Digi-Key #KC009G 10k ohm NTC unit, bend one of the leads so that both are parallel to the thermistor's body. Now, carefully solder the correct length of RG-174/U miniature coax cable to the staggered leads (see **Fig. 5**). Insert the wired thermistor into the end-cap body (leaving it about 1/4" from the top of the fitting) and cement it in place—at the entrance only—using clear silicone adhesive. The thermistor itself should be in contact with the free air inside the fitting, or white silicone heat-sink grease can be used to transfer the heat picked up by the fitting's body over to the thermistor. You'll now have a neat, protected, metal-encased thermistor package that can be bulkhead-mounted wherever you need to sense a thermal rise.

Another item that can be used for the same purpose can often be found at hamfests or swap meets. Look for an older Ohmite No. Q120 Model E wire-wound porcelain rheostat. When you disassemble it you'll end up with a threaded brass barrel with a shoulder on it, and a nice brass nut to match. The wired thermistor (as above) can be cemented inside, again providing a nice-looking, protective mounting arrangement. By the way, if you're able to acquire the blown power line cartridge fuses mentioned first, the tails on these fuses are made of heavy-gauge, stranded, tinned copper wire and are great for short high-current bonding straps or for connecting stud-mounted power rectifier diodes together. A two-for-one bonus!

The thermistor that Joel refers to in his tip can be obtained from Digi-Key, 701 Brooks Avenue South, Thief River Falls, MN 56701-0677 (Tel: 1-800-344-4539).

Cool it!

From Ken Guge K9KPM: If left idling too long, the copper-clad tip on a small soldering iron can become too hot and begin to build up oxidation. It's a problem that's easily overcome, however, by simply installing an on/off switch in the AC line cord to the iron. Use the larger type of in-line switch (the type that uses screw connection terminals on the inside) and cut just one of the iron's AC wires at the point where the switch will be easy to access. Now connect one end of each half of the cut wire to each of the switch's terminals. Don't stop there, though; also place a small silicon diode across the switch terminals. Something like a 1N4005 will do nicely (the diode's polarity isn't important in this application). Now the diode is in parallel with the switch, so the iron isn't off completely when the switch is open; that's because

the diode keeps it running at about half voltage (only the positive or negative halves of the AC sine wave get through to the iron, it doesn't matter which). When you want the iron to "idle down," simply throw the switch to "off" and it will drop to half power. When you begin soldering again, throw the switch to "on" (shorting out the diode) and the iron will come back up to full soldering temperature quickly. Most importantly, it keeps the tip from oxidizing as badly and prolongs its life significantly.

If you'd like to go one step further, mount a wall dimmer into a 4" x 4" electrical box, along with a duplex outlet. Then connect an AC line cord of convenient length to the dimmer (following the dimmer's instructions), but instead of the dimmer's output going to a ceiling lamp, it will go to the duplex outlet instead. Now when you plug your soldering iron into that duplex outlet you'll have continuously variable heat control for any size job, plus half-level for idling via the in-line switch from above. A small "night light" plugged into the remaining outlet on the duplex pair will visually show you roughly where the dimmer—and your iron—are set.

Ken's idea concludes another "Ham To Ham" column, our 10th. Thanks to all who've taken the time to write and offer their favorite suggestions so that the rest of us can benefit from their knowledge and experience. I hope you feel as I do, that this is in the very best of traditions of our hobby—one ham helping another...Ham To Ham. Let's see your ideas in print here.

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Ask Kaboom

Your Tech Answer Man

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Fixing oscilloscopes

In a previous series of articles, we explored the use of the mighty oscilloscope. Fact is, you just can't do much serious electronics work without one. Once you get used to having a scope on your bench, you'll find yourself depending on it for so many tasks that you'll wonder how you ever got along without one. So, it can be quite a problem when "old faithful" breaks down. After all, how are you going to fix your scope without a scope??

If you can, borrow one! If you can't do that, you will have to try and repair the thing with lesser instruments, like your DVM and frequency counter. Either way, fixing a scope can be a challenge. Like all repair jobs, though, sometimes it's a bear and sometimes it's a piece of cake. (Hmmm, wonder if bears like cake?)

Been there, done that?

In some ways, an oscilloscope is like a TV set, particularly because both have CRTs. That means they both use very high voltages to create and manipulate the beam that hits the screen and forms the image, and they both have circuits relating to horizontal and vertical movement of the beam.

That's where the similarities end, though. Unlike computer monitors, which are very like TV sets, scopes use some fundamentally different techniques to operate the CRT, causing them to have very different circuits and overall structure. Let's take a look, but, before we do, here comes the safety lecture again:

Like TV sets, scopes use thousands of volts to operate their RTs. Unlike TVs, though, most scopes connect the highest voltage (for the CRT anode) right at the back of the tube, on one of the regular socket pins. Compared to the nice, insulated anode cap on the side of a TV CRT, the high voltage in a scope can be much more exposed. So *be careful!* All the TV servicing rules apply, such as using only one hand when exploring or adjusting a powered unit, and discharging the power supply caps and CRT anode before messing with them.

Vive la difference!

So what makes a scope so different from a TV set? Primarily, the dissimilarities result from the scope's requirement of widely variable scan rates. A TV always scans its CRT at the same rate, which is about 15.735 kHz horizontal and 60 Hz vertical. A scope, though, can scan its tube at any rate you choose, allowing the viewing of all kinds of different signals with all manner of time periods. Without the variable scan rate, scopes would be fairly useless.

Gimme a ring

In a TV set, the beam is swept across the face of the tube by a magnetic field, which is generated by a set of coils placed around the neck of the tube. Current through the coils creates the field, sweeping the beam. Unfortunately, it's difficult to use magnetic deflection of the beam unless the scan rate is constant, because those coils have plenty of inductance (which is what makes them work, of course) and must be used in a fairly resonant condition. Essentially, it's the same situation as with SWR on your antenna: If you try and pump nonresonant energy into the deflection coil, some of it will come back at you and cause distortion of the original current waveform, or even heating and destruction of the coils, the driving amplifier, or both. That's one reason some computer monitors can be damaged if you try to run them at the wrong scan rate, and also why multiscan monitors cost more; they need special circuits to handle the different rates. Even with the multiscan units, the range of scan rates is fairly limited, varying by perhaps a few hundred Hz for the vertical, and a few tens of kHz for the horizontal.

On a scope, you might want to change the scan rate from 0.2 seconds to 0.2 *microseconds* as you examine a waveform. So, you can see why magnetic deflection just isn't practical; you're dealing with scan rate ratios of over a million to one! The way around it is to use another form of deflection: electrostatic. That's just a fancy way of saying that the presence of one electrical field can alter another. Just as the anode voltage on a CRT's face will attract the cathode's electrons to it (which is the same effect as the plate voltage on any tube, for that matter) so will another strong, positive voltage pull those electrons toward it when it's placed on the *side* of the tube. So, a scope tube has four electrode plates in its neck, one for each of the required directions of pull.

> **"A scope can scan its tube at any rate you choose, allowing the viewing of all kinds of different signals with all manner of time periods"**

High voltage

In a TV set, the high voltage is nearly always generated by the horizontal circuitry, using a "flyback" transformer. Like the deflection yoke (set of coils), the flyback is resonant at the horizontal scan rate, and can't be used over a wide frequency range. Trying to do so can overheat the flyback and, eventually, destroy it. Even more than the yoke's, the flyback's resonance requirement limits the range of available scan rates.

Thus, in a scope, the scanning and high voltage circuits must be kept separate, so while a TV can't make anything at all on the screen unless the horizontal circuits are running, the same is not true on a scope. (In fact, there are occasions when you may want to turn the horizontal scan of your scope off, such as for X–Y signal monitoring, where one signal moves the beam up and down and another one moves it left and right.)

The other elements of a scope are somewhat different, too. On a TV, the beam is scanned in a raster pattern, and the only modulation of that beam is of its intensity. On a scope, intensity is usually constant, and the modulation is of the *direction* of the beam! That means the scanning circuitry has to have amplifiers as well as oscillators. A typical scope has two amplifiers for the vertical direction, allowing the viewing of two simultaneous waveforms. The horizontal section does have an oscillator, but it often also has an amplifier, letting you use an external signal to drive the beam horizontally, for display of X–Y signal patterns.

Just as a TV has sync circuitry to keep the position of the beam lined up with the original picture, a scope has a trigger circuit to synchronize the horizontal scan with some repetitive point on the incoming signal. This is a crucial function: without it you can't see anything more than a blur on the screen.

Finally, a scope depends on a power supply, just as does any other circuit. Most scope power supplies provide several different voltages, the loss of any of which will severely disturb the scope's operation.

Where to start?

Well, what's wrong with your scope? If it died altogether, the power supply is the first place to look, of course. If the power light doesn't come on, check the fuse, and then start troubleshooting the low–voltage supply, using standard repair techniques. Many scopes use simple, linear supplies, although some use switchers. If yours is a switcher, be awfully careful when servicing it. If you don't know how to

work on switchers, find somebody who does, because they can be dangerous. In any event, simple power supply problems are likely to be caused by failed diodes, transistors and voltage regulators, or perhaps a shorted electrolytic cap.

If the outputs from the low voltage power supply are working, take a look at the back of the CRT. Its filament should glow, although the glow can be pretty dim. If you see nothing at all, follow the leads back to the board and see where the voltage disappears. It's possible for the filament to be driven from a part of the high–voltage supply, and the drive may be pulsed, so you might not be able to read it on a voltmeter. That's where another scope really comes in handy. By the way, although the filament could be open, I've never run into that problem.

Various other voltages are required on the tube in order to make a trace, and many are generated from "boost" voltages, which are intermediate voltages created by the high–voltage supply, just like in a TV set. With a TV, you can usually tell if there's high voltage getting to the tube by touching the face of the screen and feeling the crackle—not so with a scope! The voltages are lower (although they're still in the thousands), and I've never been able to feel a crackle on a scope. So, if there's no trace, it may not be obvious whether there's high voltage or not. Assume there is, as far as safety is concerned; there may still be enough voltage to kill you. To be sure, you'll have to measure it, and that requires a special probe. High–voltage failure is nowhere near as common on a scope as it is with TV sets, due to the lower voltages required, I guess. I did have one old scope that died of high–voltage failure, but it was pretty obvious, as the trace went out of focus and bloomed, a sure indicator of dying high voltage.

Well, we've barely scratched the surface of scope repair. Next time, we'll dig into it quite a bit more. Until then, 73 de KB1UM.

Got any ham related photos suitable for a 73 cover-pix??? Call Frances 800-274-7373.

Number 55 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
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Testing the Vector–Finder

As I pulled into the starting area of one of my first 2 meter hidden transmitter hunt at a hamfest in San Diego about 20 years ago, I thought I couldn't be better prepared. I had my four-element radio direction finding (RDF) quad on a mast going out of the passenger-side window, a big external S-meter on the dash, and an RF attenuator to knock the signal down into S-meter range as I closed in. The back seat was full of maps and on-foot "sniffing" gear. I was confident that I would soon bag the hidden T and have a prize in my hands.

Then the signal came on the air. What's this? It was on for a half second, then off for a half second, like the tick of a clock. And every time it came on, my meter reading was different! Sure enough, the hider had programmed his rig to change output power each time it made a half-second transmission. My big S-meter bounced around wildly as I turned the quad. Spinning it rapidly didn't help me get a bearing, because the transmissions were too short. Turning it really slowly wasn't any better, due to flutter on the signal as I began to move.

I eventually found the hidden transmitter, which was near a rutty gravel road in the mountains. All along the way, I resolved that in future I would carry some RDF equipment that is immune to changes in the amplitude of the signal.

TDOA points the way

The time-difference-of-arrival (TDOA) technique fills the need for a non-amplitude-based RDF system by picking up the target signal on two or more antennas. The relative times at which the signal wavefront strikes each antenna give clues about its incoming direction. Some sophisticated military RDF systems use this principle at fixed-site installations to get highly accurate bearings on shortwave signals. Both the incoming azimuth and elevation angles can be determined, so the distance to skip-propagated stations can be calculated. But resolving ambiguities, determining elevation, and achieving high accuracy in a non-rotating TDOA system requires at least three antennas and a very large, fast computer for signal processing. We're talking megabucks, so that's not practical for ham radio, at least not yet.

"The VF-142Q is as close as you can get to plug-and-play RDF."

Fortunately, there is a much easier way to use the TDOA principle. **Fig. 1** shows a simple array that will give sharp bearings with your VHF-FM receiver or handie-talkie. Two vertical dipoles are at the ends of a horizontal bar, supported by a short mast. It is called a "narrow aperture TDOA" because the dipoles must be a half wavelength or less apart for proper operation. A diode network switches the receiver RF input electronically from one dipole to the other very rapidly; say, 500 times per second.

The signal from Transmitter #1 arrives at Antenna A before it arrives at Antenna B. Conversely, the signal from Transmitter #3 arrives at Antenna B before Antenna A. Because the wavefronts from these two transmitters don't arrive at both antennas simultaneously, there is an abrupt phase change of the receiver input signal during the switching when receiving either one. This phase jump is detected by the receiver's FM discriminator and sent to the speaker. It sounds like an audio tone superimposed on the received audio. The tone frequency is constant at the switching rate, but its amplitude increases with increasing phase difference between the signals arriving at the two antennas.

The signal from Transmitter #2 arrives at both antennas simultaneously. Thus, there is no phase jump during switching and the tone is minimized or disappears entirely. When you have rotated the mast of a TDOA antenna set to null the tone on an incoming signal, you know that it is along the line of bearing of Transmitter #2.

No receiver S-meter is needed to get bearings with a TDOA set. Your ear easily detects the tone null. The bearing indication is very sharp, compared to the broad forward lobe of a yagi or quad. There are no strong-signal overload problems because the process uses phase, not amplitude.

The first TDOA RDF project for hams was by David Geiser WA2ANU in *QST*, July 1981. His Double Ducky Direction Finder had two vertical "rubber duckies" mounted about a foot apart on a grounded screen. This simple no-indicator TDOA implementation is still popular as a "starter" RDF system for fledgling T-hunters. You may have seen kits for similar versions, with duckies or "batwing" antennas, selling for less than $30 at a hamfest or swap meet in your area.

The packaging and antenna systems in most of these rudimentary sets leave a lot to be desired. Their biggest flaw is that they have a "figure-8" directional pattern with no built-in method for resolving the ambiguity. That's right, they give you two possible directions to the hidden

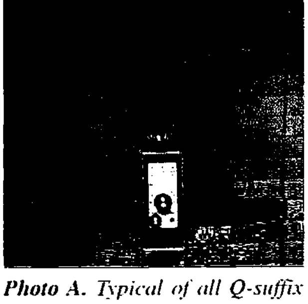


Photo A. Typical of all Q-suffix Vector-Finder RDF sets, the VF-142Q has dual dipole antennas and left-right LED indicators. The on-off push-button is mounted on the handle, like a trigger.

***Photo B.** The 2-1/2" x 6" x 6-1/4" Vector-Finder control box includes a tone pitch control, speaker, and oil-filled magnetic compass.*

transmitter, not one. When you turn the antenna and get a sharp null that indicates the signal source lies directly in front of you, it could just as easily be directly behind you! No serious T-hunter wants that.

WA2ANU realized that polarity of the phase jumps at the receiver discriminator output can be used to resolve the ambiguity. He explained the principle in his original article and in a follow-up article in the May 1982 issue of *QST*. Included was an improved Double Ducky design featuring a left-right meter indicator. With it, the TDOA technique was truly useful. Since then, several home-brew TDOA projects have been published and commercial versions have come to market. Some give left-right indications on a zero-center panel meter, while others use a pair of light-emitting diodes (LEDs).

The VF-142Q

This month, "Homing In" looks at the Vector-Finder VF-142Q, manufactured by Radio Engineers. Bob Decesari WA9GDZ formed this company in 1979 as a part-time business, and went full-time three years later. His company brought out its first TDOA RDF set for boaters in the 1980s, but I paid little attention to it because it had bidirectional ambiguity. Now Radio Engineers has added the Q-suffix series of Vector-Finders with left-right indicators to its product lineup.

The VF-142Q (**Photo A**) is as close as you can get to plug-and-play RDF. Just unfold the antenna arms, extend the whips, attach a 9-volt battery, then connect the cable to your receiver's antenna connector (BNC type supplied) and extension speaker jack. The unit comes completely assembled and tested. It is not available in kit form.

WA9GDZ put careful thought into the mechanical design of the Vector-Finder series. Antenna supports are hinged to swing out for use and to fold against the control box for storage and transport. When fully extended, the VF-142Q dipoles are 38-1/2" long, just right for 2 meters. The 17" spacing between dipoles permits operation up to 300 MHz. An oil-filled magnetic compass atop the control box makes it easy to read bearings while on foot in the field. A speaker with volume control is included, so you can hear the receiver with the audio pick-off plug inserted (**Photo B**).

A good report card

The unit I tested had good electrical balance in the antenna system and produced very sharp tone nulls on both the 2 and 1-1/4 meter bands. The left-right indicators tended to flicker on and off as turned in a full circle, which led me at first to think that the they were not working properly. But with a little practice, I came to realize that the LEDs are quite accurate and steady within ± 20 degrees of the line of bearing, where it matters the most.

I discovered that the best technique for taking a bearing with the VF-142Q is to turn slowly in a circle while listening carefully for the two nulls in the DF tone, ignoring the LED indicators for the moment. If your surroundings are noisy, it may help to plug an earphone into the front panel jack to better detect the tone nulls. When you have found the nulls, face one, watch the LEDs, and rock the unit slightly to the left and right of the bearing line. If you are facing the signal source, the "go right" LED will come on as you rotate to the left. Conversely, the "go left" indicator will light as you rotate to the right. If the opposite happens, you are facing away from the incoming signal. By walking, turning, and following the null and lights, you will approach the hidden transmitter more or less directly.

An important test of a dual-antenna TDOA RDF set is how it performs when there is high audio deviation on the signal, as often happens when hidden T's have "foxbox" tone generators. A few TDOA circuits I have evaluated in the past got good bearings on dead carriers, but the indicators were unusable when there was voice, tones, or noise on the signal. The VF-142Q processor did a good job of rejecting modulation. In the ± 20 degree range around the null, voice and tones had little or no effect on the left-right indicators. If a particular modulating tone caused blinking, it could be minimized by changing the antenna switching rate with the front panel pitch control.

Another problem with some TDOA sets is unreliable operation as battery voltage sags. Duracell specifies that a standard 9-volt alkaline battery reaches end of life at 4.8 volts. The VF-142Q produced reliable bearings all the way down to that voltage, though the LEDs became very dim. Still, this was much better than another brand I have tested, which stopped working at 7.8 volts.

I had only a few minor complaints about the VF-142Q. Light from the miniature green indicators is nearly washed out by sunlight. A hood or larger LEDs might be an improvement. The antenna switching action produces some RF hash, which closes the receiver squelch on weak signals. To counter this, I opened the squelch control completely when taking bearings on a distant T. Since the dipoles are electrically disconnected from the receiver when the trigger is not being depressed, weak signals must be monitored with the DF buzz in the background. It would be nice to have a "zero frequency" position on the pitch control so the dipoles could be used to listen to weak signals, or for transmitting.

There is no bracing to hold the four pivoting collapsible whips in place, so the dipoles can easily get knocked out of position when you are crashing through the brush on foot. The antenna arms are not detachable from the control box, so the unit cannot be easily mounted on a vehicle for mobile T-hunting. Last but not least, the bolt holding the antenna supports protrudes 3/4" from the back case, making it awkward to lay the unit on its back when you pause during the hunt.

Keep in mind that there are certain RDF situations where all TDOA models are at a disadvantage. Horizontally-polarized signals are much more difficult to track than vertical, because signal reflections are enhanced relative to the direct signal when received by the vertical dipoles. Very weak signals may be masked by noise from antenna switching. A properly polarized beam or quad works better for RDF in these special situations.

Tracking in the presence of many signal reflections (inside a building, for instance) is difficult with a TDOA. The multiple paths may make it impossible to get a good null, or the null may be off the correct line of bearing. The best way to combat this problem is to keep moving in the general direction of the signal source and take frequent bearings as you walk along.

Since amplitude of the incoming signal is ignored when your TDOA set takes bearings, you must remember to pay attention to signal level as you hunt. I have seen T-hunters following a TDOA's line-of-bearing null walk right over a buried hidden transmitter. They didn't realize that the signal had gotten super-strong and then diminished. Consider carrying along a field strength meter in addition to your TDOA set so you can tell when you are very close to the hidden T. If you can't do that, check for "You are here!" signal strength by disconnecting the receiver antenna or listening on the third harmonic frequency with your dual-bander. Take bearings continuously and verify your left-right indications to be sure you have not gone too far.

Where to get one

The VF-142Q RDF is available for $239.95, plus tax and shipping, directly from Radio Engineers, 7969 Engineer Road, Suite

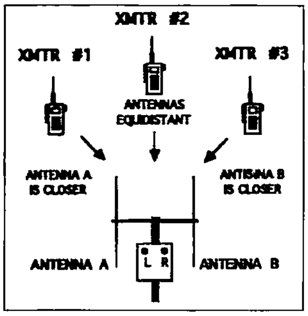


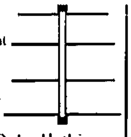
Fig. 1. TDOA RDF sets such as the VF–142Q get bearings by determining which of its two vertical antennas is closest to the transmitter. Differences in arrival time produce differences in the phase of the signals from each antenna. Accordingly, some hams prefer to call these units "phase front detectors."

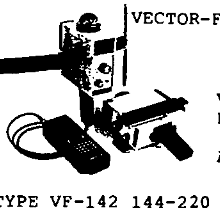
102, San Diego, CA 92111, phone (619) 565–1319. In addition, Radio Engineers makes the VF-142QM, which has a slightly different configuration of the antenna support arms. This allows them to be positioned closer together, so the unit can be operated up to 500 MHz when used with a suitable receiver. It sells for $289.95. Be sure to order a model with the Q suffix so your unit will have left-right indicators.

The TDOA method of RDF is favored by some search and rescue volunteers for tracking aircraft Emergency Locator Transmitters (ELTs). These beacons are AM signals in the AM-only aircraft band, but the TDOA RDF method requires an FM receiver. For tracking ELTs, Radio Engineers makes two Vector-Finder models called "ELT Stalkers." They include an upconverter to shift incoming 121.5 MHz signals to 146.52 MHz, where they can be received and tracked with a 2 meter FM receiver. Converters to 2 meters for 243 and 406 MHz ELT frequencies are not provided. The VF-121Q ELT Stalker (up to 300 MHz) sells for $379.95, and the VF-121QM (up to 500 MHz) sells for $409.95.

A TDOA RDF sniffer is an important addition to your T-hunting bag of tricks. When signals are strong, vertical, and in the clear, it will give sharper bearings than a beam. Bearings will be easy to take, even if the fox transmitter is changing power. Its inherently broadband antenna system will give you RDF capability over a wide frequency range.

Do you know of a new or novel RDF product? Tell me about it, so it can be considered for a "Homing In" review. Write to the address atop this article or send e-mail to me at Homingin@aol.com or 75236.2165@compuserve.com. 73





ATV

Ham Television

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For those of you who enjoy surfing the Internet, you'll find lots of ATV information online. A number of ATV groups and individuals have taken advantage of the capabilities of the World Wide Web to provide net surfers with a wide variety of entertaining web pages. You'll find basic information about getting started in ATV, pictures of local ATVers, circuit diagrams, construction articles, product reviews and recommendations, event schedules and announcements, as well as operating hints. A couple of groups actually offer live digitized still-frame images of their ATV repeater so you can check in remotely from anywhere in the world. WA6ZJG in Alameda, California, even has a live tower camera that updates every three minutes that you can rotate by clicking your mouse!

"A couple of groups actually offer live digitized still-frame images of their ATV repeater so you can check in remotely from anywhere in the world."

The real power of these Internet web sites is the linking capabilities to other pages anywhere in the world. You might be cruising through the Arizona site and with one mouse click you are instantly transported to the German ATV. I've found that as you cruise through each group's pages you'll find all kinds of interesting links to related information about television, video digitizers, R/C aircraft, kites, and balloons. Just be sure that you have a lot of time set aside before you begin browsing since, once you've started cruising these ATV sites, it'll be difficult to stop.

ATV web sites

The URL address given for the following groups should be entered into your web browser to access each site; you'll find that each group usually will have links set up to other ATV pages. The Arizona Amateurs on ATV page, the ATN group of Southern California, and the German group appear to have the most extensive list of links that I have found. Once you have found the link page, you can cruise to all of the other groups easily with just one mouse click. It's a good idea to bookmark each group's page so you can return easily without having to type in the address.

Alabama

The Tennessee Valley ATV group has a web page giving a description of their repeater system on top of Monte Sano mountain in Huntsville, as well as operating news and net times. *http://fly.hiwaay.net/~bbrown/tvatv.htm*

Arizona

The Arizona Amateurs on Television home page shows club members' photos, ATV pictures from events, an ATV manufacturers' list, a club calendar and links to other sites. *http://www.hayden.edu/guests/aatv/*

California

Southern California. The Amateur Television Network (ATN) of Southern California has several pages devoted to their extensive system of linked ATV repeaters, club newsletters, and digitized photos of their members. *http://www.ladas.com/ATN/*

San Francisco Bay Area. This intriguing site operated by WA6ZJG of Alameda offers live video images taken from the W6CX ATV repeater as well as a remotely controlled (via the Internet) tower camera with updates every three minutes. *http://citynight.com/atv* and *http://citynight.com/camera*

Visalia. Operated by KC6YRU, this site offers practical information for the beginning ATV operator. *http://www.valleynet.com/~jreeves/atv.html*

Florida

The LISATS group (Launch Information Service and Amateur Television System) provides information about their repeater system in Cocoa, Florida, complete with a list of touch-tone commands. *http://calvin.ksc.nasa.gov:1080/lisats.html*

Georgia

The Atlanta area ATV page has descriptions of both the N4NEQ and W4ZTL ATV repeater systems. Construction diagrams for their popular Hawg Fence and Hawg Amp circuits are available, as well as members' photos. *http://www.mindspring.com/~rwf/aatn1.html*

Germany

This site describes the PI6ANH ATV repeater system in Arnhem, The Netherlands, and is a cooperation of German and Dutch amateurs. It contains an excellent description of their repeater and has a lot of useful construction projects online. *http://www.regio.rhein-ruhr.de/hamradio/atv/*

Maryland

The BRATS page (Baltimore Radio Amateur Television Society) lists upcoming activities and events, net times and information about their W3WCQ ATV repeater. *http://www.smart.net/~brats/*

New Jersey

The Brookdale Amateur Television Repeater System page offers block diagrams of their repeater, some product reviews and modifications, and photos of their repeater system. *http://www.njin.net/~magliaco/atv .html*

Ohio

The ATCO page (Amateur Television in Central Ohio) has online versions of their very popular newsletters, net information, and a map of active ATVers in the state. *http://psycho.psy.ohio-state.edu:80/atco/*

Pennsylvania

The Carnegie Tech Radio Club W3VC shows some intriguing ways that ATV has been used in their annual "buggy" competition. *http://www.contrib.andrew.cmu.edu/org/ar99/w3vc.html*

Tennessee

The East Tennessee ATV group has information about their repeater on top of Buffalo Mountain. Check out the "old page" for a neat special effects photo of their repeater. *http://www.geocities.com/SiliconValley/1242/*

Texas

Houston. The Houston Area Television Society (HATS) has a listing of their club meetings and location, a description of their ATV transmitter kit, and some useful test screens in GIF format. *http://www.stevens.com/hats/home.html*

United Kingdom

This page provides a description of the Solent Club for Amateur Radio & Television (SCART). *http://www.inside-info.co.uk/scart.htm*

Utah

The Utah ATV home page is managed by Clint KA7OEI and describes the WB7FID and KA7OEI ATV repeaters. They offer links to a variety of ATV related activities (balloons, mountaintopping, R/C planes, and astronomy experiments). *http://uugate.aim.utah.edu/utah_atv/root.html*

SSTV

This multimedia page has loads of information about Slow-Scan TV. A must-see page for anyone with an interest in this popular mode. *http://www.ultranet.com/~sstv/*

R/C Aircraft ATV

Carl Berry K5MWN has put together a very detailed and informative site that describes how to build a remotely-powered vehicle with an R/C plane, and a converted arcade game that actually puts you in the pilot's seat via ATV and telemetry. His system is called the Cyclops. Included are links to other R/C sites on the web. *http://198.83.140.5/~cyclops/cyclops.html*

High altitude balloons

For those of you with interests in flying ATV onboard high altitude weather balloons, or those who would like to know when a flight is scheduled, there are several sites that have popped up from the more active balloon groups across the country. These sites can all be accessed via the EOSS (Edge of Space Sciences) home page at *http://www.usa.net/~rickvg/eoss.htm*; links to the other balloon groups can be found in their "Information about other Balloon Groups" section. You'll find telemetry information, launch and recovery photos as well as several incredible photos taken from the edge of space.

There is a Amateur Radio Balloon Symposium in Iowa this July; check out the detailed information about the symposium in the "News from other Balloon Groups" section.

"As you cruise through each group's pages you'll find all kinds of interesting links to related information about television, video digitizers, R/C aircraft, kites, and balloons."

Kites

This page had some intriguing info about using telemetry in their altitude record attempts for kiting. Fun reading. *http://www.magic.ca/~kite*

Internet live cameras

Check out Leonard's Cam World page for links to numerous live camera sites accessible via the Internet. *http://jax.jaxnet.com/~len/camera.html*

Netcruising

I hope you enjoy your cruise down the information highway. If your group is online and not listed here, please feel free to E-mail me at *bbrown@hiwaay.net* and I'll update the information in a future column. 73

Number 60 on your Feedback card

CARR'S CORNER

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Radials For Your Antenna

Radials are quarter-wavelength (usually) pieces of wire connected to the ground side of the transmission line to an antenna. These radials can be on the surface of the Earth, under the surface, or elevated, depending on the particular antenna. The radials are used to form a counterpoise ground, i.e. an artificial ground plane. It is seen by the antenna as essentially the same as the ground.

"Whatever type of antenna you put up, make sure that it is in a location where it cannot possibly fall over and hit a power line."

Ground level configurations should be buried, rather than on the surface, to prevent injury to people passing by, either from RF burns or stumbling over the fool wire. But what do you do in a limited space situation?

Figs. 1 and **2** show the most common forms of radial installation. In **Fig. 1** we see the radials connected to a vertical antenna that is mounted above the ground (usually quarter-wavelength or some convenient height). The radials are connected to the shield of the coaxial cable. They may be at a drooping angle (as shown) or 90° from the radiator element (i.e. horizontal to the ground).

The version shown in **Fig. 2** is used with ground-mounted verticals (the base insulator is not shown here). A ground rod is recommended, and it should be a long one. The television type (typically three or four feet long) is not sufficient. Use an eight-foot copper or copper-clad steel ground rod for the best results. The shield of the coaxial cable is connected to the ground rod. The radials are fanned out from the top of the ground rod and extended as far as necessary.

The radials in this illustration are buried several inches below the surface in order to prevent anyone from tripping on them; some nasty injuries can result from such a fall. Also, wires buried underground tend to come to the surface from time to time, so either bury them deep (like below the frost line, which is 28 inches in my neighborhood) or perform regular inspections to ensure that they are still where they are supposed to be—underground.

The radials should be made of AWG 14 or thicker wire, and the wire can be either insulated or bare. Even underground it matters little which is used. A lot of people use the same type of wire that is used for antennas in their radials, AWG 14 copper-clad steel wire.

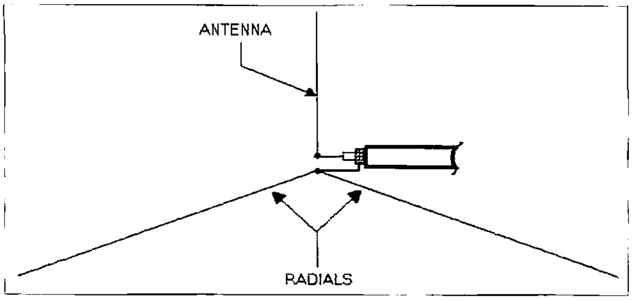

Fig. 1. Radials connected to a vertical antenna that is mounted above the ground. The radials are connected to the shield of the coaxial cable.

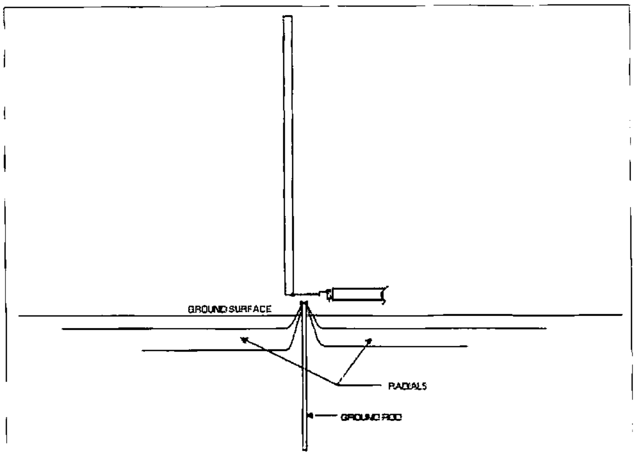

Fig. 2. Radial installation used with ground-mounted verticals (base insulator not shown).

Fig. 3 shows the method for connecting the radials to the ground rod. There is almost always some sort of wire collar on commercially produced ground rods. If not, then get a wire clamp from the electrical section of a do-it-yourself hardware store (some of which also sell ground rods of suitable length). A relatively healthy number of radials can be accommodated under the clamp. Make sure that the clamp is tight, and that the screw or hex nut holding the wires is well set. The wire to the shield side of the coaxial cable is also connected at this point.

How many radials?

Boy! Am I gonna get hollered at! Every time I write about radials the number of radials goes up. And it seems that there is a lot more heat than light out there in Readerland over this matter. But cool off, and I'll share my opinion with you... and it's an opinion that is backed up by both practical experience and the antenna engineering literature.

The minimum number of radials is one. But a one-radial antenna system isn't going to work very well. I've done it, but only as a get-on-the-air-as-fast-as-possible temporary measure. One time, right after we moved into our first house, I mounted a 20 meter Hustler mobile antenna to an upstairs windowsill, and ran a 16-foot radial out to a nearby tree. It worked, and worked pretty well considering what it was—and didn't even burn up my aging Heathkit HW-101 transceiver. But it didn't work nearly as well as the half-wavelength dipole and commercial trap vertical that went up two weeks later. As a practical minimum, you need at least two radials for each band of operation, and four radials per band is better. The radials should be spread out symmetrically around the antenna.

Now that we've established a practical minimum, what does the antenna engineering literature say? The charts and graphs show that up to 120 radials per band are useful. Commercial radio stations operating in the medium waveband, AM BCB and under, tend to use that many radials. But if you look at the charts, you see a distinct knee between 14 and 18 radials where there is a downward trend in the effectiveness of each additional radial. In other words, it's a point of diminishing returns. One of the most vicious reader letters I've ever received flamed me for recommending no more than 16 radials, and held fast to the 120 radial scheme. It didn't make any difference that sources such as Bill Orr's *Radio Handbook*, *The ARRL Antenna Book* and other well respected sources—including two of the principal college-

level antenna textbooks—confirmed the 16-radial-per-band practical limit. Oh well, that same idiot also flamed me for claiming that the maximum feed point impedance of the usual quarter-wavelength vertical is 37 ohms ... with four pages of calculus he proved conclusively that the real value is 36.6 ohms (sighhh).

> ***"Wires buried underground tend to come to the surface from time to time, so either bury them deep or perform regular inspections to ensure that they are still where they are supposed to be—underground."***

Limited space radial layout

If you live on a small lot, then the radials problem is a little more daunting, but it's not insurmountable. A representative solution is shown in **Fig. 4.** The radials shown in textbooks are straight, and that is the preferred configuration. But if you don't have the space, then you need to use some variant of the two paths shown in **Fig. 4.** The radial can either go around the perimeter of the property, or zigzag back and forth in either a triangle or rectangle pattern (the latter is shown here). I've even tacked radials to the baseboard of a student boardinghouse room (not recommended over a few watts QRP power levels).

Antenna safety

Every time I write about antenna construction I like to talk a little bit about safety. The issue never seems too old or too stale, because a lot of people out there never seem to get the word. Antenna erection does not have to be dangerous, but if you do it wrong it can be very dangerous. Antennas are deceptive because they are usually quite lightweight, and can easily be lifted. I have no trouble lifting my trap vertical and holding it aloft ... on a windless day. But if even a little wind is blowing (and it almost always is), then the sail area of the antenna makes it a lot heavier (or so it seems). Always use a buddy system when erecting antennas. I have a bad back caused by *not* following my own advice.

Another issue is electrical safety. Don't ever, *ever*, ***ever*** toss an antenna wire over the power lines. ***Ever***. Period. Also, whatever type of antenna you put up, make sure that it is in a location where it cannot possibly fall over and hit the power line.

The last issue is to be careful when digging to lay down radials. You really don't want to hit water lines, sewer lines, buried electrical service lines, or gas lines. Heck, I know one property where a long distance oil pipeline runs beneath the surface. If you don't know where these lines are, try to guess by looking at the locations of the meters at the street, and the service entrance at the house. Hint: Most surveyors' plats (you know, those map-like papers you get at settlement) show the locations of the buried services. They should also be on maps at the local government offices (although you might have to go to two or three departments!). The utility companies can also help.

Be safe, be happy or, as Mr. Spock put it, "Live long and prosper."

Connections

I can be reached at P.O. Box 1099, Falls Church VA 22041, or via E-mail at CARRJJ@AOL.COM. I welcome your correspondence. One thing does tend to annoy me, though. Please don't call me on the telephone. A number of readers have done that recently. In the past, I didn't mind so much because only a few people every year called, but the traffic has increased quite a bit. Although I try to be polite and helpful, it almost always interferes with some activity. I arise every morning in time to arrive at my office at 7 a.m., and that means I go to bed early. And while the caller almost always thinks he has kept to the polite "before 10 p.m." rule, the call nonetheless wakes me up. I make it a point to answer all E-mail and try to answer as much snail mail as I have time for, so please don't call. 73

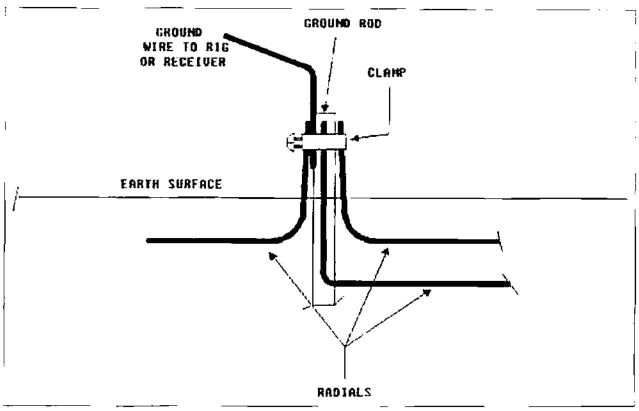

Fig. 3. *Method for connecting the radials to the ground rod.*

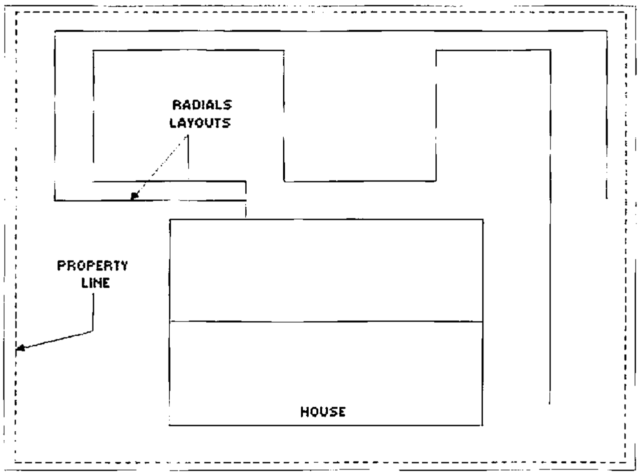

Fig. 4. *A straight radial configuration is preferable, but if you live on a small lot and don't have the space, use some variant of the two paths shown above.*

LETTERS

Continued from page 35

beginning—this from someone who has been fighting an uphill battle learning the code. I really enjoy sitting down practicing code with my SCS. I now have the way to not only learn the code for the test, but to enjoy using the code. Thanks, Wayne, for featuring this great unit in your magazine. Keep up the great work in bringing some really exciting things to us as you have with this unit. And thanks to Sam Ulbing N4UAU for inventing the Super CW Station.

Now don't you wish you'd saved your June '95 issue?... Wayne

Jim Thompson KC7APO. This letter is in response to "Dots and Dashes" by Hal Goodman W3UWH in the March issue. I've been a ham for just over two years. Like Mr. Goodman, my first few CW contacts were unforgettable. The day my license came in the mail it was hard to decide whether to fire up the Ramsey kit I had built or the Collins KWM2A I had picked up along the way. The coin came up tails so I turned on the Ramsey and it barely worked; just a problem with microphone mismatch, but the group on the 2 meter repeater helped me figure that out. After meeting several people and having a great time, I cleared and turned on the big radio. It took me a while to find a clear frequency and tune up for the first time (lucky I did not fry the finals!). I sent CQ on the 80 meter Novice band with a very shaky fist. After the second attempt, I began to wonder if I was getting out with only 100 watts. The third time, I got an answer from a fellow in Northern California. The QSO was brief, but it was my first CW contact and that does not happen very often (actually just once).

I was soon to meet many "Old-Timers" like Hal, who were very supportive and helpful. Much of what I know I learned from them and I am grateful. If I've ever said "thank you" to those guys, I probably can't say it strongly enough.

I quickly found out that learning the code was just the beginning. There are abbreviations, standard procedures, and phrases to learn that are barely covered in the books. That's fine; there's nothing wrong with the books. Just realize that, in many ways, the first ham ticket is just a "license to learn."

Much of my early copy looked like Hal's copy from Bill and, at first, I assumed that it was my faulty ears. I heard lots of characters that I couldn't identify or that never formed recognizable words. There was one time I thought I heard my name as "Wim." I listened carefully the next time and convinced myself that that was what he was actually sending. So I corrected him and he replied, "QSL Wim, got ya." I was learning.

Another time I turned it over and the fellow replied, "S" "O" then a pause and I thought, "Aha, a word." So I wrote down "so" and listened for the next. Then came "L, I, D" and I thought, "Aha, another word." So I wrote it down. Two words in a row! But then I began to wonder, "Wait a minute, is this guy calling me names? I'm new to this, but am I that bad?" The next word was of course, "COPY," but after that my self–confidence was so badly shaken that I copied little of what followed. Finally I realized that the guy was still sending and that I'd better get my pencil going. It ended up that he was really a friendly chap after all and the mistake was all mine. I copied all the characters just fine but of course there is more to it than that.

I listened carefully to the good counsel of these "Old-Timers" and learned lessons like: Don't send faster than you want to receive and don't be afraid to send PSE QRS. I also learned from the mistakes of others and strove to develop a good fist and operating habits. I started with a straight key, picked up paddles and found it all too easy to send those extra dits and dahs. I finally got a bug, learned to use it, and liked it. With the bug, I made far fewer mistakes than with paddles and was more relaxed than I was with a straight key.

The first step to good keying is to hear the sound of the character

Continued on page 86

Number 62 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

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This column marks the beginning of the 20th year of *RTTY Loop*. Twenty years is quite a milestone. Just look at what postage and interest rates have done over that time. Just look at interest in ham radio over that time! Overall, though, we're still doing OK. Because of the personal computer revolution, interest in digital communication has never been higher. Your letters and E-mail have shown me that. I am also aware, however, that any number of you feel that the old-timers are ignoring the fundamentals and basics when speaking to newbies. In this month's column, and the next several, I'll address that need.

We throw around terms and concepts as if they were common knowledge, forgetting that even the most seasoned among us once regarded the acronym AFSK as newspeak gobbledygook. My intent has always been to address the wide spectrum of amateurs interested in digital communications and computers. Having dealt with lots of cutting-edge questions of late, let's define some terms.

This month, I present a glossary for radioteletype and digital communication. Because there are those of us who are still using old paper printers, and those who are using fancy computer interfaces, this list will attempt to encompass terms used in both camps, with some others thrown in. If you have any additional vocabulary words you think should be included in the list, feel free to send them along. I'll keep an updated copy of this list on the RTTY Loop Home Page, for reference.

AFSK: Stands for Audio Frequency Shift Keying and is a means of encoding the digital information by changing the frequency of an audio tone.

AMTOR: Derived from a commercial mode, SITOR, Amateur Teletype Over Radio allows the receiving station to dynamically respond to errors from the sender.

ASCII: The American Standard Code for Information Interchange, this seven-bit scheme for encoding alphanumerics is the standard computer code used.

Baudot: A five-bit code which is used to encode the alphabet and numerics, through use of a shift into an alternate character set, this is the original Teletype code. Also called the Murray code.

"Many of you feel that old-timers are ignoring the fundamentals and basics when speaking to newbies."

Bias: With conventional digital signals, the state of the signal alternates between **MARK** and **SPACE,** with the length of pulses in either state the same. If the relative length of the pulses is unequal, the system is said to exhibit various kinds of bias.

Chad: When you punch a hole in a piece of paper, the plug that comes out is called a "chad." Paper tape, punched with many holes to serve as a memory device, generates tons of these chads.

Chadless: Obviously, without chads. If you want to type on the tape with the holes in it, the absence of paper where the holes are makes it difficult. Chadless tape leaves the plugs attached by little lips, to permit such typing.

CPU: Central Processing Unit, the brain of a computer. Common CPUs in home computers are Intel series 80386 and 80486, part of the x86 line, and Pentiums, as well as the Motorola 68000 series in the Macintosh computers.

Demod: Short for Demodulator, this is the electronic marvel that converts the warbling tones of radioteletype from a receiver into pulsed DC that a Teletype machine can interpret.

Fox Tape (or Key): There is a marvelous sentence that contains all the letters of the alphabet: THE

QUICK BROWN FOX JUMPS OVER THE LAZY YELLOW DOG. People frequently have a tape to send this for test purposes. Digital or computer setups may have this sentence reprogrammed at the touch of a key.

FSK: Stands for Frequency Shift Keying. Similar to AFSK, the frequency of a radio carrier is shifted to encode the digital information.

Governor: Not the person in your state capitol. Mechanical teleprinters are run by motors, and it is important for the motor to be turning at a precise speed. Older machines, or those intended for AC/DC work, used a governor on the motor to set the speed. A special tuning fork is used to set the motor speed.

Local Loop: If you hook all your equipment together so that anything you type on the keyboard prints on the printer, kind of like a big electric typewriter, that's a local loop—essential for testing.

MARK: Spelled differently than my first name, this is the state when everything is running quietly, and loop current is present. Could call it "1" if you're into logic.

Model 12, 14, 15, 28, 32, 33, 35, etc.: These are different series and styles of teleprinters and tape machines produced by the Teletype Corporation. The Model 15 is the classic keyboard and page printer on a table, seen so often in police and science fiction movies of the 1950s and 1960s. The Model 19 is the Model 15 with built-in Model 14 tape equipment. In general, the higher the number, the more recent the equipment manufacture.

Modem: A combination Modulator, for sending digital data, and Demodulator, for receiving. May be used for radio or telephone, for a variety of modes.

Packet: A scheme for sending digital data in discrete packets, which are acknowledged by the receiver after sending. Each packet can be addressed to a specific receiver or for wider distribution, making transmission more reliable.

Page Printer: If the teleprinter prints on a roll of paper which, when you tear it off, looks like a page, then it's a page printer.

Patch Panel: One of those can't-do-without things. Usually a jack strip which allows anything to be connected to anything (anything?).

Perforator: A keyboard connected to an electromagnetic device which punches tape as you type is a perforator. This cannot punch tape from an incoming signal.

Polar Relay: Normal spring-return relays take more energy to make than to hold. This would cause distortion in a digital signal, called bias. A polar relay uses two magnets, one to make and one to break, to overcome this problem. A bias (no relation) supply is needed for one of those windings.

RAM: The read-write memory populating home computers is commonly referred to as Random Access Memory, even though most memory boards, whether read-write or read-only, are random access.

Reperforator: A tape punch which decodes incoming signals and punches them into tape is a reperforator. Some versions type on the tape at the same time, and are called Typing Reperfs, of course, and are chadless.

RTTY: The ham's abbreviation for radioteletype.

RY: These two letters contain all the bits in the commonly used five-bit Baudot code. Therefore, repeating the letters, as RYRYRY, makes a good test signal.

SPACE: See also **MARK**. This is the state without loop current. Machines in such a state just shuttle back and forth making noise, called running open. This is the logical state "0."

Strip Printer: No, not what you're thinking; this is a printer which, unlike the page printer, prints its data on a narrow strip of paper, like a stock ticker.

Synch Motor: Since the motor for a teleprinter has to be a precise speed, it is nice to synchronize it to the 60 Hz line frequency. It takes the place of a governor motor.

TD: Stands for Transmitting Distributor, which is quite a mouthful, making the abbreviation convenient. This is a tape reader—so why couldn't they just say that?

TNC: Terminal Node Controller—the interface box used between the radio and terminal for packet mode communication.

TT, TTY: More abbreviations for **Teletype.**

Teletype: The whole ball of wax we are talking about. This is a trademark, however, of the Teletype Corporation, and should always be capitalized.

TU: Stands for Terminal Unit, and is the same thing as a Demodulator.

Once again, I welcome input to this list, both additions and corrections to my definitions. Send them to me via any of the means at the end of the column, and watch for updates on the RTTY Loop Home Page, at http://www2.ari.net/ajr/rtty. Also up there is the latest version of the RTTY Loop Software Collection, featuring over a dozen disks of data, along with old columns and links.

Several of you have been looking for the latest addition to Gary Johnson's XCOM software; check out the XCOM page at http://www.indirect.com/user/gjohnson for the latest and greatest, direct from the author.

As for me, reach me on the page, through the E-mail link, or at ajr@ari.net, or on America Online as MarcWA3AJR, or on CompuServe as 75036,2501. Or, if you have no other way, at the post office box above. Use that address, as well, for materials for the Software Collection.

I plan to continue the beginners' introduction next month, with a look at just why, and how, the alphabet can be encoded over a single wire circuit. Please feel free to send along comments, questions, or suggestions. I look forward to them!

Ham Radio Fun

Number 64 on your Feedback card

Communications Simplified, Part 7

AM sidebands.

Peter A. Stark K2OAW
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Mt. Kisco NY 10549

Let's review a little. Awhile back, we learned that a square wave consists of a fundamental frequency and some harmonics. We made a rather sweeping statement that any repetitive waveform can be broken down into a fundamental and/or some harmonics.

Let's start this segment off by putting down a general rule, and then we will explain it: *When a carrier with frequency C is modulated by an audio (or other) signal having frequency A, we get two sidebands, whose frequencies are C+A and C-A. Moreover, at 100% modulation, the two sidebands are exactly one-half the size of the carrier.*

Let's consider an example. Suppose an AM radio station at 880 kHz transmits a carrier whose amplitude is 100 volts when there is no modulation (that is, when there is no sound being transmitted). If you looked at this signal with a spectrum analyzer, you'd see just a carrier, as shown in **Fig. 1**.

Now suppose the announcer steps up to the mike and whistles a 1 kHz note into it, loud enough to produce exactly 100% modulation. If you looked at the transmitter output with an oscilloscope, you would see a 880 kHz carrier, whose envelope goes up and down at a 1 kHz rate, but if you looked at that same signal with a spectrum analyzer, you'd see the picture shown in **Fig. 2**. You would still see the same 100 volt carrier at 880 kHz *(which never changed amplitude)*, plus a 50 volt signal (called an *upper sideband*) at 881 kHz (881 is 880 plus 1 kHz), and another 50 volt signal (called a *lower sideband*) at 879 kHz.

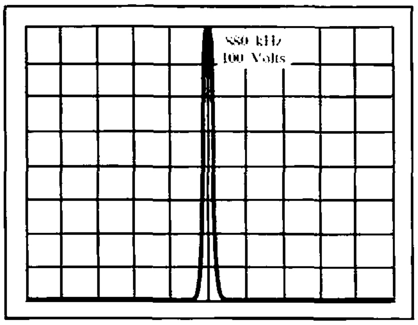

Fig. 1. An unmodulated carrier at 880 kHz.

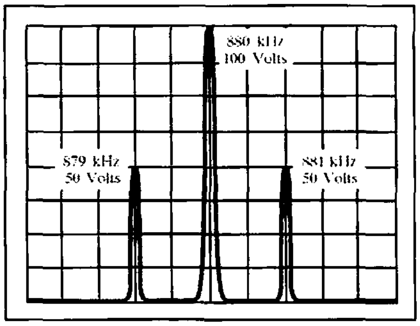

Fig. 2. 880 kHz carrier modulated 100% by 1 kHz.

So what's really happening is that the radio station is generating a 880 kHz carrier, and then AM modulating it (changing its amplitude) at a 1 kHz rate. On the air, we actually have an 880 kHz carrier which has a constant amplitude, plus two extra signals called sidebands. These sidebands also have a constant amplitude, but when we see the combined signal on an oscilloscope, all three of these interact together to make it *look* as though the carrier is changing height.

Fig. 3 shows how this is possible. This is a computer-generated graph, which shows three sine waves at the top, and their sum on the bottom. The bottom waveform is simply the point-by-point sum of the top three waves. At the far left and far right, the three top waves are pretty much in phase, and so they add up to a big result. In the middle, however, the two sidebands are out of phase with the unmodulated carrier, and so they cancel it out to produce a very small result.

DETOUR

Here's the BASIC program which draws the same waveforms as in **Fig. 3**:

```
10 'Generate AM from sidebands
20 SCREEN 2
30 FOR X=0 TO 639
40 CARRIER=SIN(X/10.185616#)
50 UPPER=.5*SIN(X/10.185616#*1.1)
60 LOWER=.5*SIN(X/10.185616#*.9)
70 AM=CARRIER+UPPER+LOWER
80 PSET(X,20-20*CARRIER)
90 PSET(X,60-20*UPPER)
100 PSET(X,90-20*LOWER)
110 PSET(X,150-20*AM)
120 NEXT X
130 IF INKEY$="" THEN 130
140 SCREEN 0
```

END OF DETOUR

Look at **Fig. 3** some more. Suppose this graph covers exactly one second of time. Since the unmodulated carrier on top has exactly 10 cycles, its frequency is exactly 10 cycles per second, or 10 Hz. It's a little harder to count the cycles of the AM signal on the bottom, but it too has exactly 10 cycles, and therefore is also exactly 10 Hz. Now look at the envelope of the AM signal; draw it in, if that will help. The envelope starts big, goes to small in the middle, and then becomes big again, so it has exactly one cycle during that second, and is therefore at 1 Hz. So we have a 10 Hz carrier, modulated by 1 Hz. (These frequencies are not exactly practical for real radio, but they are nice simple numbers, and easy to visualize.) According to our

previous discussion, the two sidebands should therefore have frequencies of 11 and 9 Hz (which is 10+1 and 10-1).

Sure enough, if you count the cycles of the two sidebands, you can see that the upper sideband has 11 cycles, while the lower sideband has only nine cycles. Their frequencies are therefore 11 Hz and 9 Hz, respectively.

Note also that the AM signal is modulated to 100%—you can see that its amplitude goes all the way to zero. You can also see that the two sidebands are each exactly one half the size of the unmodulated carrier.

Let's go back to the 880 kHz transmitter example (refer to Part 6, in the June 1996 issue of *73*, if necessary). The carrier voltage V_c is 100 volts. When the two 50 volt sidebands are in phase with the carrier, all the voltages will add up to a V_{max} of 100 + 50 + 50, or 200 volts. On the other hand, when the two sidebands are out of phase with the carrier (look at the center portion of **Fig. 3** to see how this happens), they all subtract to give us a V_{min} of 100 - 50 - 50, or 0 volts.

So we now have two ways of determining the percentage of modulation of an AM station: Look at it on the oscilloscope, or look at it on the spectrum analyzer. For example, what is the modulation percentage for the signal in **Fig. 4**?

Let's see, the carrier has a height of about 6.4 divisions. Since we can't see the knobs on the analyzer, we don't know how many volts that is, but that doesn't matter; 6.4 divisions is good enough for us. If that signal were 100% modulated, then the sidebands should be half of 6.4, or 3.2 divisions, but they are only about 1.7 divisions high. So the modulation is only 1.7/3.2 of its maximum. That works out to:

$$\frac{1.7}{3.2} \times 100\% = 53\%$$

So far, so good. Now that we've gotten so good at this, let's look at a *real* AM broadcast station on the analyzer and try to figure out what their percentage of modulation is. It's actually quite easy; we just have to throw some wire out the window and connect it to the analyzer's input, and we get **Fig. 5**. We still see a nice carrier, but on each side we now see just plain fuzz, rather than a neat sideband. What's going on?

The difference is that the real station isn't broadcasting just plain tones—their audio consists of music and speech. This includes many different frequencies, all at different amplitudes but at the same time. Every single frequency in the audio generates its own pair of sidebands. So we have many sidebands, all occurring at the same time, and all constantly changing as the music or voice changes. The result? A fuzz that actually extends past the edges of the analyzer picture.

To avoid confusion, some people use the term *side frequency* when they describe the sideband from a single tone, as in **Fig. 4**. They would then say that all of these different side *frequencies* combine to make the two side*bands* in **Fig. 5**, a lower sideband to the left of the carrier, and an upper sideband to the right.

Bandwidth

Our simple example with the announcer whistling at 1,000 Hz showed that the radio signal would consist not just of the carrier at 880 kHz, but also of sidebands (side frequencies) at 879 and 881 kHz, 1 kHz away from the carrier on each side. AM broadcast stations normally transmit voice or speech with a frequency range of about 50 to about 10,000 Hz—not quite hi-fi, but still higher than just 1 kHz, and since the side frequencies lie at the carrier frequency plus and minus the audio frequency, we will now have side frequencies that lie anywhere from 50 Hz to 10,000 Hz away from the 880 kHz carrier. In other words, the sidebands will extend 10 kHz out from the carrier in both directions, down to 870 kHz on the left, and up to 890 kHz on the right.

The complete radio signal will, therefore, take up 20 kHz of space on the band (from 870 to 890 kHz), and so we say that the bandwidth of the AM signal is 20 kHz. We can summarize it this way: *The bandwidth of an AM signal is twice the highest audio frequency being transmitted.*

The bandwidth is related to how close stations can be placed to each other on the dial; the wider the bandwidth, the farther apart they have to be. To limit the bandwidth of commercial broadcast stations, the FCC limits their audio frequency range to a maximum of 10 kHz, which sets the maximum bandwidth at 20 kHz. Actually, though, AM broadcast stations are placed farther apart than their bandwidth would indicate, because the tuned circuits in most radios are not good enough to separate stations that are too close together. For example, in the New York City metropolitan area, stations are typically 50 or 60 kHz apart.

Sideband power

When a transmitter sends out sidebands, it needs power to do that. Let's consider a commercial AM broadcast station which sends out a 5 kW carrier. If the cable leading from the transmitter to the antenna has an impedance of 50 ohms, then we can find the output voltage by solving the power equation $P = V^2/R$ backward for the voltage:

$$V = \sqrt{P \times R} = \sqrt{5000 \text{ watts} \times 50 \text{ ohms}} = 500 \text{ volts}$$

When the station modulates that carrier at 100%, it still sends out a 5 kW (500 volt) carrier, but now it also sends out two 250 volt sidebands.

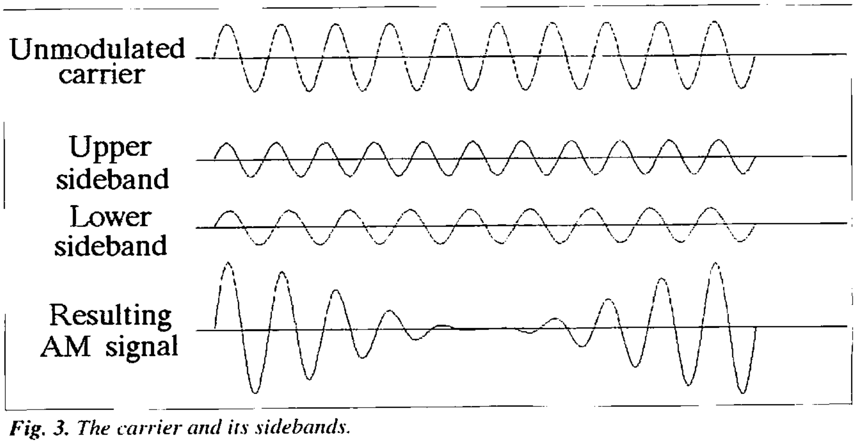

Fig. 3. The carrier and its sidebands.

Each of those also goes into the 50 ohm cable, so the power in each sideband is

$$P = \frac{V2}{R} = \frac{250^2}{50} = 1{,}250 \text{ watts}$$

The transmitter is now putting out 5,000 watts into the carrier, plus another 2,500 watts into the two sidebands, for a total of 7,500 watts.

Efficiency

The amount of sideband power depends, of course, on the modulation percentage. From the $P = V^2/R$ equation, we see that the power is proportional to the square of the voltage. Thus, cutting the modulation down to 50%, for example, drops the sideband voltage to 1/2 of the 100% value, and so drops the sideband power to 1/4. Cutting the modulation percentage to 10% would drop the sideband voltage to 1/10, and the sideband power to 1/100. So in normal speech or classical music, where the volume is seldom at its maximum, the modulation percentage and sideband power tend to be much smaller than the carrier power. On the other hand, in modern popular music, where it seems like everybody is constantly yelling and screaming (to my jaded ears, anyway), the average modulation percentage would be higher, and the sideband power also.

In any case, we now know that the carrier in an AM signal never changes; only the sidebands change, depending on the signal being sent. We also know that the carrier contains most of the power of the AM signal. But is it really needed?

If the carrier never changes, then it doesn't carry any information to the receiver. By the time it gets to the receiver, it is just a weak sine wave. In fact, if the transmitter somehow turned the carrier off (sending only the sidebands), and the receiver had a circuit which generated a substitute sine wave of the right frequency, amplitude, and phase, it would never know the difference. But generating a weak sine wave at the receiver is a lot cheaper than generating a high power carrier at the transmitter.

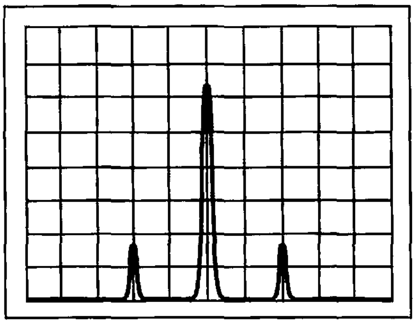

Fig. 4. What is the modulation percentage?

This is the basic idea behind several variations on AM; changes which make both the transmitter and receiver somewhat more complex, but which greatly increase the efficiency of the system by reducing the transmitter power. These two major methods are called double sideband (DSB) and single sideband (SSB).

Double sideband

DSB is also sometimes called DSSC, which stands for double sideband suppressed carrier, a name that describes it well. In DSB, the transmitter sends out only the two sidebands and eliminates the carrier, which is then reinserted by the receiver.

Although the transmitter could produce regular AM and then filter out the carrier, this approach would waste power. A better approach is to use a *balanced mixer* to produce the DSB directly. In the balanced mixer, two AM signals are produced at low power, and then combined in such a way that the carrier gets canceled out.

The major advantage of DSB is efficiency. Consider, for instance, the 5,000 watt AM transmitter we discussed a moment ago. At 100% modulation, the transmitter would have to add 2,500 more watts for the two sidebands, for a total power output of 7,500 watts. On the average, considering typical voice or music, the sidebands might only contain a total of 1,000 watts or so, but the transmitter must still output the carrier. So its average output power might be closer to 6,000 watts. If it could eliminate the carrier, then it would need only to output an average 1,000 watts or so for the same sideband strength, and the resulting signal would travel just as far.

Alternatively, if you didn't mind spending the money, you could put all 6,000 watts into the sidebands, and get the same punch as if you had an AM transmitter of perhaps 20,000 watts or more. There would be still another advantage, too: When two signals are close together in frequency, they interfere with each other and it turns out that most of the interference is between the carriers, not between the sidebands, so eliminating the carriers would eliminate much of the interference. In fact, during silent passages there is no interference at all since the sidebands are only there when there is something being transmitted.

By now you're asking, "If DSB is so wonderful, why doesn't everyone use it?" There are two answers to that: (1) It has some disadvantages, and (2) there's something even better.

One disadvantage is that it makes the receiver more complicated. In commercial broadcasting, the philosophy has always been to make the receivers as cheap as possible so everyone can afford one, even if that makes things more expensive for the broadcasters. DSB doesn't fit into that pattern.

A second problem is that inserting a fake carrier in the receiver is not that difficult, but making sure that it is just the right frequency and amplitude is tricky. Putting it at the wrong frequency is the same as putting the sidebands in the wrong place; if the frequency difference between the carrier and the sidebands is wrong, the frequency of the audio will be wrong too. Even a slight difference, on the order of a small fraction of a percent, can make voices sound funny, and make music inaudible.

So DSB would be okay for voice communications, but not really for music. (There are some places where it is used for music, as in stereo FM, but that's a special case, because some extra circuitry is used there to help the receiver put the carrier in the right place). For strictly voice communications, there is something even better: SSB.

Single sideband

If you look at any of the spectrum analyzer pictures of AM (**Figs. 2** or **5**), you will note that the lower sideband is

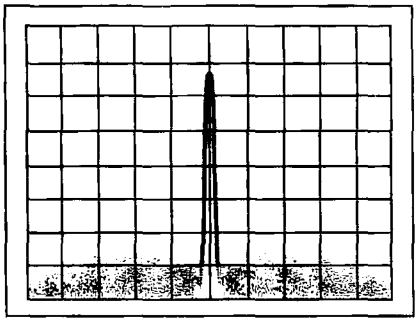

Fig. 5. An actual broadcast station.

always the mirror image of the upper sideband. For every side frequency component in the lower sideband, there is also a matching side frequency component in the upper sideband. So why does the receiver need both sidebands? It doesn't.

As long as the receiver gets one sideband, it gets all the information there is. It's sort of like you mailing a letter to a friend, but putting a second copy of the letter into the same envelope just in case. That second copy doesn't really tell your friend anything new. Unless the first copy gets damaged, of course, but in that case the second copy probably will too.

That is the idea behind SSB. With it, the transmitter sends only one sideband—no carrier, no second sideband. There are two ways to do that. One way is to generate a DSB signal, but then filter out one of the sidebands; the other is to generate two DSB signals in such a way that adding them cancels out one of the sidebands because it is out of phase in the two signals.

Let's look at the advantages of SSB:

1. It's much more efficient than plain AM, and even twice as efficient as DSB. No output power at all when there is no audio.

2. It causes even less interference to other stations than DSB, which also has no carrier.

3. It's half the bandwidth of AM or DSB. Remember that the bandwidth of an AM signal is twice the highest frequency being sent. For example, a telephone-quality signal with audio from 300 to 3,000 Hz would have an AM or DSB bandwidth of 6,000 Hz. With SSB, on the other hand, the bandwidth is only 2,700 Hz (since that is the frequency difference between the side frequency caused by a 300 Hz signal and the side frequency caused by a 3,000 Hz signal).

The bandwidth is important for several reasons. First, it means that twice as many stations can be crammed into the same band as AM or DSB (actually, more than twice, because there is so much less interference between them). Equally important is the fact that the receiver can now have tighter filters, which can do a better job rejecting other noise. The noise power picked up by a receiver is proportional to the bandwidth; cutting the bandwidth in half cuts the noise power in half too.

What about the disadvantages? The major one is that it is even more difficult for the receiver to decide where to put its fake carrier. With DSB, at least the receiver can simply put the carrier exactly midway between the sidebands. With SSB, there is no midpoint. In fact, unless the user knows whether the transmitter is sending the upper sideband or the lower sideband, the receiver may not even know which side of the sideband to put the carrier on.

Tuning in an SSB signal is difficult. Even very expensive receivers require the user to adjust the tuning until "it sounds right." That may be close enough for voice, but useless for music. Hence, SSB is used only for radio voice communications, never for music (although SSB is used for certain wire-line communications with better results, but there again there are special tricks used to give the receiver additional information to help it generate the right carrier).

Vestigial sideband

As we mentioned in an earlier installment, the bandwidth of the composite video signal in a TV is approximately 4 MHz. Since AM is used for transmitting the picture in commercial TV, modulating this composite video signal onto a carrier would normally result in an 8 MHz bandwidth (twice the highest frequency in the picture), but TV stations are only allowed 6 MHz bandwidth (and some of that has to be used for the sound carrier).

The solution used for TV is *vestigial sideband*. The word vestige means leftover or remainder. TV transmitters transmit the entire upper sideband, but only a part (the "vestige") of the lower sideband.

For example, TV's channel 2 occupies frequencies from 54 to 60 MHz. The picture carrier is at 55.25 MHz; the upper sideband goes from 55.25 to 59.25 MHz, the full 4 MHz, while the lower sideband goes from 55.25 MHz down to 54 MHz, just 1.25 MHz. Even though most of the lower sideband is missing, the upper sideband contains all the information that the TV needs to properly receive the picture. We should mention that the top part of the 6 MHz channel is used for the sound signal, which has a carrier at 59.75 MHz, but this part is sent as FM (or frequency modulation), so we will leave that discussion for later. For now,

DETOUR

Here's an interesting calculation you can do yourself.

We've already said that, when an AM carrier is modulated 100%, each sideband is 1/4 the power of the carrier. With two sidebands, that increases the power by 1/2. Here is how to check that.

Fig. 6 shows 10 cycles (20 half-cycles) of a 1 volt unmodulated carrier on the left, followed by 10 cycles (20 half-cycles) of a carrier modulated 100% on the right. Since the formula for power is $P = V^2/R$, the power is proportional to the square of the voltage. So let's square the voltage of each half-cycle of the unmodulated carrier on the left, and add up all the squares to get some idea of the relative power (ignore the units). Each half-cycle is 1 volt, whose square is also 1. For 20 identical half-cycles, the sum is 20.

Now repeat the same for each half-cycle of the modulated carrier. For example, the shaded half-cycle has a height of about 1.2 volts, so its square is about 1.44. Repeat that calculation for each of the 20 half-cycles (some are so tiny they are hard to see) and add up. You should get a sum of about 30, which is 1/2 more than 20.

This calculation shows that the total power of an AM signal increases by 50% when it is fully modulated. As we explained before, this extra power all goes into the two sidebands.

END OF DETOUR

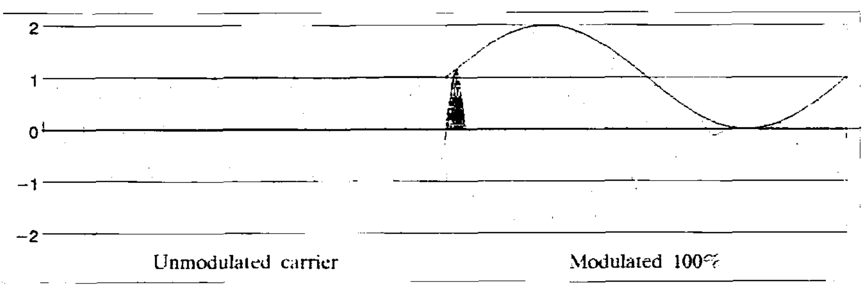

Fig. 6. Calculating the power of a 100% modulated carrier.

it's just important to mention that the TV picture and sound carriers are purposely different so that they cause as little interference with each other as possible.

Conclusion

Amplitude modulation is used in a number of important places. Commercial AM broadcasting uses it, of course, but so does TV (although with a vestigial sideband). It's also used in the aircraft band, and by international broadcasters on the shortwave bands.

In amateur radio and other point-to-point communications, however, AM has been replaced by other modulation methods. SSB is important, but so is FM and various digital pulse methods (both will be discussed in future installments of this series).

NEVER SAY DIE

Continued from page 39

Imagine, convincing people to spell the words the way they sound! Impossible, of course. Yet, anyone who's done much CW work is used to abbreviated spelling, so this just might present some fertile ground to start the change. Fb om es cul, right?

The booklet is available from Radio Bookshop for $5 postpaid in the US and Canada. For foreign mailing please add $1.

If you know people who teach school you might get them to try Ray's ideas out on their kids and see what they think. Lemeno.

Math Problem

A fax arrived from Irwin Math WA2NDM, who writes a column for *CQ*. He was worried that some careless souls might hop into the Happy Hunting Ground via the Bioelectrifier described in the May *73* via passing the current through their hearts. In my AIDS booklet I do stress the importance of *not* passing the 50 µA from arm to arm. Yes, I know, a lot of experimenters have done it and none have, as far as I know, done themselves in. But why take chances?

The article says to pass the current from one ankle artery to the other. Bob Beck called to say *not* to use any metal around the ankles, as the author did. That can give burns. He says to use an inch or so of solid bare wire wrapped in flannel and tied in place with a silk thread. Then soak it in a saltwater solution.

On the other hand, since any experimenting on live people must be done by a doctor, presumably the doctor will know better than to zap the heart. But then they have a license to kill, so one never knows.

I wanted to reassure Math that the base was covered, but he forgot to put an address or fax number on his fax, so I looked into *CQ* for his address. None given there either. But while I was looking for his column, which was indexed to be on page 86 (I finally found it on page 40), I couldn't help but notice that most of the magazine was devoted to columns. I counted 9-2/3 pages of feature articles and reviews, and the rest of the 134-page magazine was devoted to columns and ads. From page 34 onward it was all columns! Only one of the articles was construction oriented—a simple antenna switch. Say, I wonder when editor K2EEK is going to get his General ticket and join us on the low bands?

One of the reasons I got fired as the editor of *CQ* after five years at the helm was my insistence on publishing construction projects. Speaking of which, I counted 26 pages of feature articles and reviews in *our* May issue.

Getting back to the Bioelectrifier, getting viruses and other crud out of the blood is beneficial, but with HIV you also have to chase it out of the lymph glands, where it can hide for years. Beck has a simple system for doing this. He wound a small coil, about 150 turns on an old VCR spool, and put it in series with a flash-gun bulb. This provides a short blast of about 20,000 gauss, which Beck says knocks the virus out of the lymph gland and into the blood stream, where a Bioelectrifier can keep it from attaching to the white cells.

At the Tampa Global Sciences Congress, Beck also reported that he'd been using the coil-flash unit on his head and, as a result, was sporting a new head of hair. Beck, by the way, has the original patents on flash guns. Let's see, I wonder how much an old flash gun is going for at flea markets now?

If that also counts as a medical procedure, then it should be done under a doctor's care. I dunno. I'm just reporting what I've seen and heard. But if you have a heart pacer, I hope you won't be dumb enough to jump-stop it with the coil.

If you'd like to hear Beck's fascinating one-hour talk for yourself, it's available for $10 from Radio Bookshop as item BB-1.

The Numbers

The latest FCC count from Gettysburg tells the story. Let's compare the number of General, Advanced, and Extra Class licensees between 1982 and 1996; 14 years, 320,249 - 242,583 = 77,666 gain. That's a 2.3% gain per year in 14 years. Less than a three percent growth for 14 years! Heck, we're probably dying faster than that! Those figures count nine years of dead hams, plus nine years of who knows how many dropouts who won't bother to renew.

Yes, the Novice and Techs have grown from 164,866 to 393,322 in the last 10 years, for an average growth of 13.9% per year! And almost all of 'em are still up there on 2m. Maybe you can figure some way to get 'em Generalized and down on our HF bands. I tried hard with *Radio Fun* and I failed to make a dent. Since the written exams are so easy to memorize, it has to be the dreaded code that's gradually killing our hobby.

Are the Techs coming to your club meetings? If not, why not?

You're probably right. I should shut up about this and let what's going to happen, happen. Heck, I don't even know how to motivate people to stop killing themselves and their families with poisons and poor nutrition.

HAARP News

Unless you've been living in a cave somewhere, you're at least somewhat aware of all the fuss over the government's multi-megawatt plans to blow holes in the ionosphere with an Alaskan research project called HAARP. Nick Begich, whom I met at the Tampa Global Sciences conference in January, is the author of *Angels Don't Play This HAARP: Advances In Tesla Technology*.

A letter from author Fred Jueneman (I reviewed his *Raptures of the Deep* for you) had an interesting comment on the project. "If HAARP, in its wildest dreams, does succeed in short-circuiting the ionosphere to the surface of the Earth, or by some extension of the same principle, short-circuit the Van Allen Belt with its four million ampere current, this might momentarily negate the Earth's magnetic field, resulting in an effect known as the Giauque-Debye adiabatic demagnetization—a technical mouthful meaning that with the precipitous loss of a magnetic field an extreme cooling results. If HAARP somehow manages to short-circuit the Van Allen Belt, this effect is what I anticipate would occur. The results are so much more devastating in magnitude that they would make any thoughts of the destruction of the ozone layer pale in comparison.

"I'd expect that such a massive electrical discharge would make the ionosphere flare up like a multi-colored fluorescent display, sending spectacular streamers throughout the upper atmosphere. What could happen next with the almost instantaneous cooling of the polar air is the precipitation of the atmosphere itself like snowflakes in a blizzard over a rather sizable area. This adiabatic effect could create an equally sizable vacuum that would be filled by onrushing atmospheric air from the more temperate regions of the Earth's surface, generating winds of tornadic force which would level everything in their paths.

Continued on page 77

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ABODE & BEYOND

VHF and Above Operation

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The wideband FM Gunn transceiver

Gunn oscillators and wideband FM for communications were covered in detail in the April 1990 issue of this column in *73*. I have received many requests for information on how to set up a simple Gunn system, so I will cover part of that information again.

Why use a simple Gunn diode oscillator for microwave communications? Well, what the Gunn diode oscillator system has going for it is that it's a low cost method of getting into microwave operations. I'm happy to comply with readers' requests—for those interested in microwave operation, 10 GHz FM provides the easiest minimal cost system to put together. The equipment that will be described here functions very well and is capable of commercial-sounding full-duplex audio. I have to apologize for skipping this simple mode of operation as I have moved on to more costly and complex SSB communications schemes. Let's go back to my roots on 10 GHz.

Scrounge yourself a simple transceiver

In the beginning, all microwave components were not created equal, and their prices were high, keeping many amateurs from obtaining them. That prevented many amateurs from investigating operation on our microwave bands. Amateurs being what they are, avid scroungers soon broke the price barrier ($10 to $15 each), noting that a simple Gunn oscillator from a burglar alarm unit could function in a 10 GHz WBFM communications system.

This unit is a simple form of the very popular Gunnplexer™ from Microwave Associates, the premiere WBFM transceiver. Most of the component parts for this simple version can be scrounged, and it can be assembled at home. (Of course, if you want the best and easiest WBFM operation, purchase a Gunnplexer from M/A: these units are costly, but they function perfectly.)

Bits and pieces can be obtained through diligence and the constant combing of local resources. (*Caveat*: This information might not be as timely as it was several years ago when material was more plentiful.) Where do you find transceivers? Look in your own back yard: in the burglar alarm, garage door opener, and shopping center supermarket door opener industries. A lot of these devices are microwave, operating at 10525 MHz in the common use frequency band. This frequency is just above our 10 GHz amateur band and these devices can be adjusted down into our band very easily. Just increase (in most cases) the penetration of the frequency tuning screw into the cavity to lower frequency to WBFM frequencies of approximately 10250 MHz.

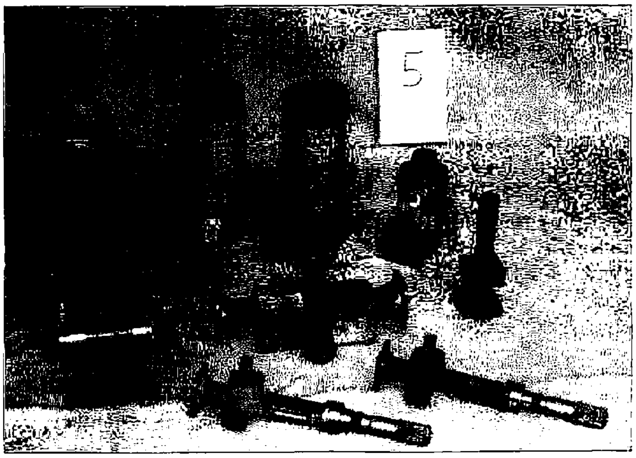


Photo A. Cavity wave meters (frequency meters) suitable for measurement at 10 GHz. The devices in the front row are slide-screw tuners, detector mounts and a sliding short for waveguide analysis.

"For those interested in microwave operation, 10 GHz provides the easiest minimum-cost system to put together."

If you go to suppliers or alarm companies, tell them you are looking for the metallic microwave units and are not interested in reusing them for alarm purposes. If they still have some of these units in their junk rooms, this strategy will usually work. If not, units can still be purchased from various sources and swap meets for a reasonable cost (not over $20 for a working cavity). New cavities from alarm company suppliers might go up to the $35 or so price range.

Most of these cavities employ a Gunn diode and a detector diode within the same cavity arrangement. Usually the Gunn diode is isolated in the rear and the detector diode is forward-mounted in the open end of the waveguide. The Gunn diode is fed from a power supply modulator circuit which reduces a 12- to 14-volt source to a regulated (variable) output voltage of 7 to 10 volts. The "adjust" terminal of the power supply regulator is modulated with a small AC voltage from an audio amplifier which is microphone-driven.

The mike amplifier is capacitively coupled to the adjust terminal of the regulator (an LM-317 variable voltage regulator). This regulator is preset to a voltage between 7 and 10 volts for proper Gunn operation. When you vary the voltage regulator's adjust pot, the Gunn's voltage will vary and so, slightly, will the frequency of the Gunn oscillator. With the adjust pot, it's just a slow frequency change that might be plus or minus 3 to 5 MHz or so. This is the fine frequency control for the simple Gunn oscillator. The M/A Gunnplexer uses a varactor frequency control, making for far superior control and frequency adjustment.

FM modulation is the very rapid changes (AC audio impressed on the adjust terminal) causing the audio voltage changes to frequency modulate the voltage regulator voltage setting, and, thereby, the carrier frequency. The audio changes are transparent to the adjust terminals fine control. It's like two signals riding the same control, one fast (modulation) and one slow (fine frequency adjust of the DC voltage output).

The minute audio voltage changes control the FM deviation of your oscillator. These millivolt changes (AC) cause the voltage regulator's output voltage to vary accordingly, slightly up or down. This depends on the waveform being positive or negative at a particular instant. Positive adds to, and negative subtracts from, the overall output voltage. Its effect is to reproduce your speech (voltage changes) on the Gunn diode, producing frequency modulation. The exact level of the audio driving the regulator sets the deviation and is somewhere around 50 to 100 kHz wide bandwidth, producing commercial sounding audio. That's why it is called WBFM, wideband FM.

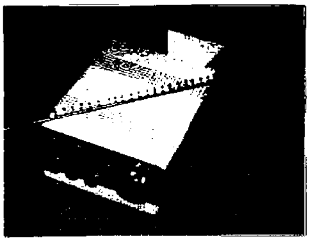


***Photo B.** The antenna on top of the rig is a 40-element loop yagi for 10 GHz. It measured 15.5 dBi at the Central States VHF Antenna Contest. (Photo courtesy of Kent WA5VJB.)*

Not too bad, considering the minimum parts count to produce a microwave transmitter circuit with voice modulation. You have only used a Gunn diode in a cavity, an op amp and one voltage regulator. For now it's sufficient to say that the Gunn diode is oscillating on some frequency in the 10 GHz range. To set the frequency, a waveguide frequency meter is perfectly suited as its accuracy (plus or minus a few MHz) is sufficient for WBFM operation. (Note: A wavemeter is not suitable for narrowband SSB or narrowband FM operation. Narrowband FM is what is generated by a VHF HT.)

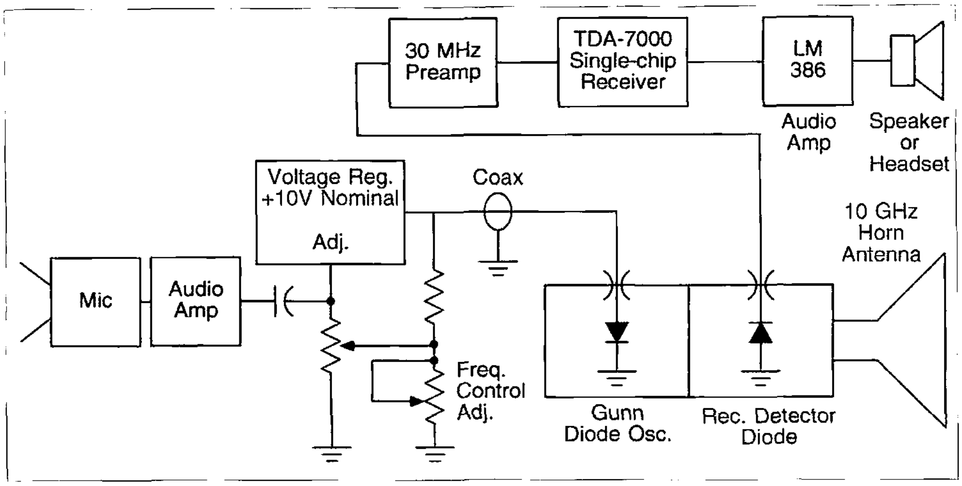


Fig. 1. Block diagram for a 10 GHz wideband FM Gunn transceiver.

A frequency counter is required for SSB/FM narrowband operation due to the more exacting frequency requirements imposed on narrowband operation. In trying to contrast these two modes of operation, I like to envision WBFM looking for a detectable signal in 250 kHz or 1/4 MHz bites as opposed to looking for a similar narrowband FM or SSB signal in 2 kHz bites, which is some 100-200 times more critical in terms of frequency bandwidth.

"Our Microwave Group in San Diego was founded on the use of WBFM and simple Gunn transceivers; the cost was minimal, and it got about 20 to 25 people on the air."

The receiver circuit

The receiver circuit is not quite as simple as the transmitter described above. The receiver consists of a detector diode in the front end of the Gunn diode cavity structure, normally coupled to a 30 MHz RF preamplifier to amplify the small signal recovered from the detector diode (mixer) and pass it on to the main IF amplifier/audio amplifier circuit. The IF amplifier that I used is a complete FM radio receiver (IF amplifier in this case) on a single 16-pin chip (Signetics TDA-7000). It is capable of operation up to 120 MHz. We have determined that an IF of 30 MHz is quite satisfactory and is becoming a standard for WBFM operation on the microwave bands.

The TDA-7000 chip IF amplifier that I used is capable of detecting a signal of 10 microvolts and producing a full quieting audio output. Coupling it with a simple single-stage RF amplifier, such as a 40673 MOSFET or a U-310 JFET amplifier, will improve sensitivity to a fat tenths-of-a-microvolt or so.

The complete schematic of the circuit (**Fig. 1**) shows how simple it is. Basically, the circuit is a free-running L/C-controlled oscillator operating on a low frequency of 70 kHz (internal to the TDA-7000 chip). The coil and capacitor that determine frequency are set to resonate at 30 MHz. I used a 1.8-inch shielded miniature slug-tuned core to wind 12 to 13 turns or #20 gauge enameled wire for the main oscillator coil. Add capacitance to tune to 30 MHz with the core adjustment and capacitor value. The exact capacitor value will vary due to coil "Q" and exact size and construction techniques. This is not exact, so a fudge factor is appropriate here.

We use 30 MHz as our IF frequency, which is produced by mixing two different signals—the same as in any receiver. However, when you look at **Fig. 1**, you'll notice that there isn't a separate local oscillator to mix with the incoming received signal, as you might expect. In this receiver the local oscillator signal is actually provided by the transmitter itself. As long as the two transmitters are offset by 30 MHz each transmitter can also act as the receiver's local oscillator, producing a 30 MHz IF signal to feed to the TDA-7000.

Here's how it works. Unit #1 sets his transmit frequency to 10250 MHz, and Unit #2 sets his transmitter 30 MHz to either side of Unit #1's—let's say 10280 MHz. Back at Unit #1, the 10280 MHz signal from Unit #2 is being received in the horn antenna. This signal mixes with some of the 10250 MHz being transmitted out of the Unit #1 dish, and produces a 30 MHz difference frequency. (The receiver detector diode is actually acting as a mixer.) This difference frequency is processed by the TDA-7000 as an IF frequency and demodulated. On the other side of the link, Unit #2 is still transmitting on 10280 MHz. He receives the 10250 MHz signal from Unit #1, which mixes with his transmitter frequency. This produces a 30 MHz difference frequency in his feedhorn, which gets passed to his receiver circuit. As long as the two stations are offset by 30 MHz—one high, and one low-full-duplex conversations can take place.

Now, don't be gullible—this is not all rosy. The operation is true and works, but there are some small hitches to this mode of operation.

First, you have to have some test equipment to set frequency. even though the frequency is a very wideband FM mode of operation. It will be somewhat frustrating trying to keep a free-running Gunn oscillator near the 100 kHz or so band widths of simple burglar alarm type cavities that exhibit limited electrical frequency tuning. More expensive cavities solve this deficiency by placing a varactor to adjust the cavity frequency about 60 to 80 MHz, making frequency adjustment a very simple manner. But,

Photo C. Jack N6XQ on Mt. Soledad assembling his WBFM M/A rig on his 30-inch dish. This is a popular spot in San Diego for contacts to Mexico, Los Angeles and beyond as it's an almost all over-the-water shot. I have observed microwave ducting from this location many times.

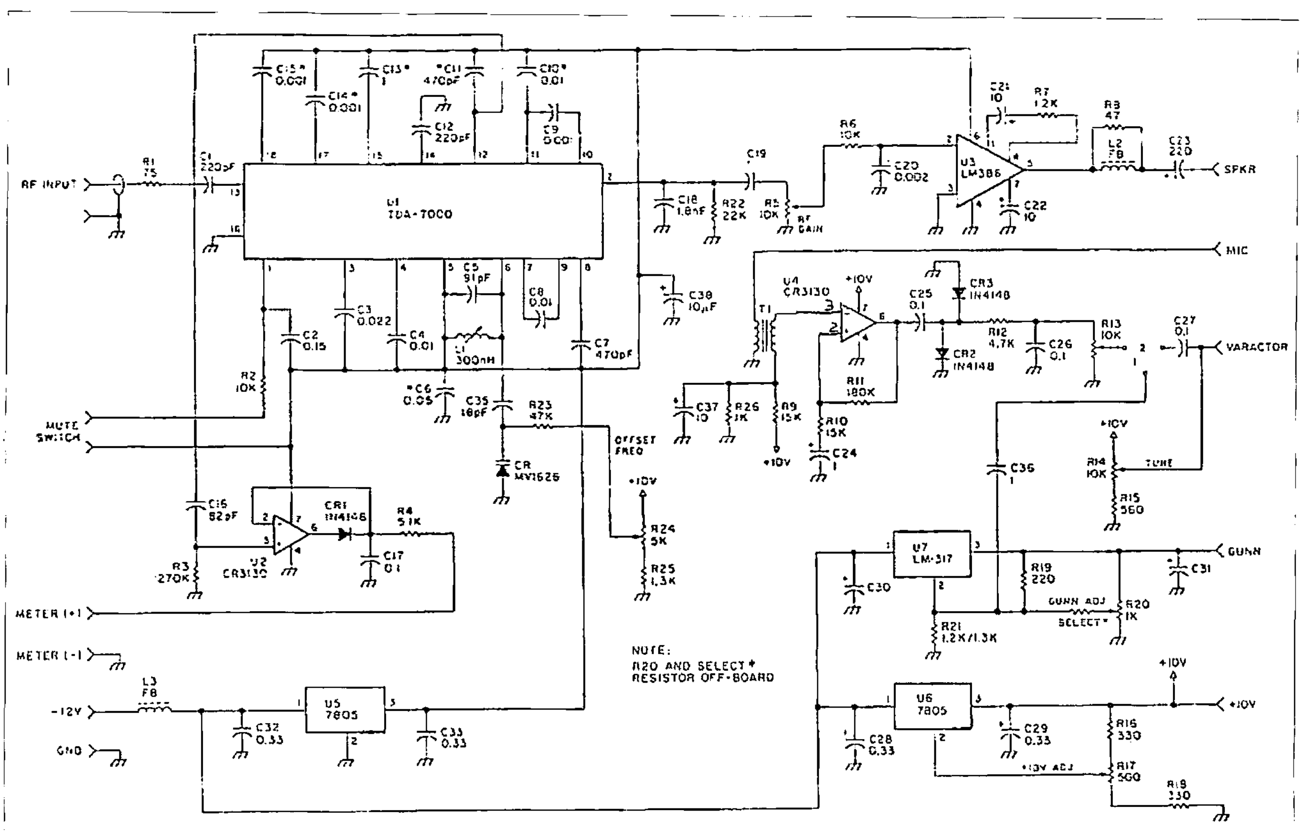


Fig. 2. Schematic for a 30 MHz IF power supply and transmit modulator control circuitry for a complete 10 GHz communications system.

as in the difference between a Chevy and a Caddy, price looms as the great separator.

If you are asking yourself what basic system you want to play with for microwave, I suggest you get the Chevy. For all its faults, it will not bankrupt you and, for a limited output of cash, it will let you test the microwave waters. This column is intended to provide you with a guide to a circuit that works. It is by no means the last word, but rather a starting place for inexpensive experimentation.

Sure, there are much better modes of operation, and far more sophisticated circuitry will blow the doors off this project, but then there goes the Caddy vs. Chevy talk. That discussion can go on to time's end. The real end to the discussion is what you want to accomplish. If you want to get your feet wet and test the waters, try this approach. If it doesn't meet your needs, go on to another fishing hole or try another microwave frequency band.

Our Microwave Group in San Diego was founded on the use of WBFM and simple Gunn transceivers: the cost was minimal, and it got about 20 to 25 people on the air. Our use of WBFM lasted for several years and produced some very amazing contacts. We became quite proficient in operation and new improved methods. Simple things like "Where is north?" and "I mean *that-a-way*" are not accurate enough for pointing a dish antenna at microwave frequencies. Accurate pointing has to be dealt with when you want to remove pointing errors and make microwave contacts.

PC board available

There are several things that need to be addressed in this arena and will be dealt with in next month's column. Let's wrap up the receiver construction and get this project on the road. I am told that I can replenish my stock of TDA-7000 chips if I order 100 devices. I am placing an order as this is being typed and will have PC boards and data with the TDA-7000 chips available for $12.50 postpaid to US destinations. I will toss in some capacitors (tantalum) and a few other parts that I have on hand to assist you in the parts count (this is a freebie on my part because I have extra components on hand). I am hoping the chips arrive from the factory in a timely manner; I am quoted eight to 10 weeks' delivery time. I also have a quantity of new 30 MHz TTL clock oscillators for use as test generators. If you want the TTL 30 MHz oscillator add $2. I know you will want one as we will build test equipment with it next month.

Board test

As with any construction project, check it out with an ohmmeter. Check out the voltage regulator circuit with a resistance load, not with the Gunn diode. Make sure everything works as expected before you try the circuit and the Gunn detector diode as a complete package. As you test the variable voltage regulator circuit, check out the 30 MHz preamp. Inject a signal with a signal generator and see if the circuit is functioning at some specific frequency. Frequency prior to adjustment could be anywhere from 20 MHz to 70 MHz, depending on the components and values used.

I connect a signal generator and tune for the frequency of operation. When you find out where the circuit is receiving, you can trim the coil slug or add capacitance to bring the circuit to resonance near 30 MHz. The signal generator method works for a first cut as it tells you what the sensitivity and approximate frequency of operation are. When completed, both units should be set to exactly 30 MHz; or, if in doubt, set them to the same frequency (you can use the TTL 30 MHz oscillator for alignment). If other units are to be used they also should be set to the same standard: either exactly 30 MHz or all the same frequency.

Now, the other alternative to building the PC board 30 MHz IF amplifier: Use an inexpensive 88 to 108 MHz FM portable radio along with the modulator voltage regulator circuit. It's the same thing, except there's one provision: The stations you wish to

Continued on page 79

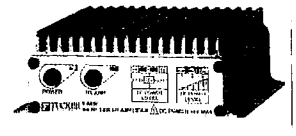
Number 72 on your Feedback card

NEW PRODUCTS

V-100W

Two 2m Amps from Tucker

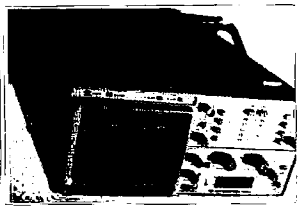
The new V-35W 2m VHF amplifier from Tucker Electronics features a built-in 15 dB preamp and a unique DC Monitor Meter that provides the operator with a constant reading of DC input voltage. The V-35W will accept 0.5-8W input power and produces up to 35W of output power. It operates on both FM and SSB/CW and is equipped with a built-in RF power meter.



V-35W

Tucker has also introduced the V-100W, which will accept 0.5-8W input power and produces up to 100W of output power. An input power signal of only 0.5W is required to produce 50W of output power, and 3-8W will drive the V-100W to full power output of 100W. Like the V-35W, it features a built-in 15 dB preamp and a built-in RF power meter.

Both amplifiers are designed to be used with 2m HTs and low-wattage 2m desktop transceivers, and both are covered by Tucker Electronics' one-year warranty and 30-day "Satisfaction Plus" no-questions-asked return policy. For more information, contact Tucker Electronics at 1717 Reserve Stree, Garland TX 75042; phone (800) 559-7388 or FAX (214) 340-5460.



Stop drifting!

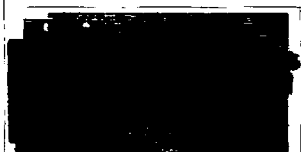
B+K Precision has just introduced four new spectrum analyzer models that are guaranteed to drift less than 0.150 MHz per hour, and this guarantee is good for a full year after purchase. All four models have stability and dynamic range equal to that of spectrum analyzers costing thousands of dollars more.

Two optional accessories are available: a battery pack to make the analyzers truly portable, and a 75Ω to 50Ω impedance matching adapter, to extend the analyzer's usefulness to 75Ω applications.

Models 2615 and 2620 are ideal for applications of up to 500 MHz. They include scanwidth selectors and an LED readout. Model 2620 also includes a tracking generator, a frequency synchronous signal source. Models 2625 and 2630 have AM and FM audio modulation to allow the user to listen to and identify RF signals. Model 2630 also includes a tracking generator.

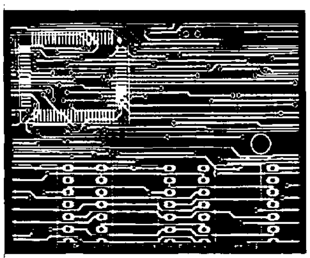
For more information or the name of the nearest B+K distributor, call 1-800-462-9832 or write B+K Precision, 6470 W. Cortland St., Chicago IL 60188.

Manufacturers: if you would like to have your products reviewed here, please call Fran at 603 924 0058.



ID to Interface Kit

Compared to high-priced modems and units costing five to 10 times as much, ITU Technologies' new Caller ID to PC Interface Kit is a price and performance breakthrough. It measures only 2.25 by 3 inches and can be plugged directly into any spare PC serial port. Software is included with the kit, for DOS and Windows-based programs. The ITU Caller ID to PC Interface Kit is a bargain at $39, plus $5 shipping and handling, from ITU Technologies, 3477 Westport Ct., Cincinnati OH 45248-3026. Call (513) 574-7523 or FAX (513) 574-4245.

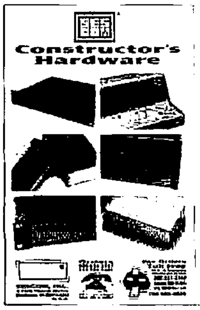


Produce perfect double-sided layouts in record time!

Number One Systems, in Cambridgeshire, England, is justly proud of the new, fast, powerful MultiRouter. Designing an autorouter to handle today's complex and dense layouts is no easy task, but the latest autorouting technology gets your routes through where other routers fail.

MultiRouter is a 32-bit multipass, shape-based autorouter. It uses proven push-and-shove and rip-up-and-retry techniques to achieve 100% completion on most layouts, and MultiRouter is so fast and easy to use, you could be looking at your first fully routed layout within an hour of installing the software. Surface-mount components? Memory Planes? No problem for MultiRouter!

MultiRouter works with Number One Systems' well-known PCB layout tool Easy-PC Professional XM. Together they form one of the fastest and most effective PCB design systems available for the PC and, priced at only £295 and £245 respectively, they are accessible to all PCB designers. US prices (including airmail) are $575 for MultiRouter; $475 for Easy-PC Professional XM. For further information contact Roger Wareham, Number One Systems, Harding Way, ST IVES, Huntingdon, Cambridgeshire PE17 4WR, Great Britain. Telephone +44 1480 461778; FAX +44 1480 494042. E-mail: rmw@numberone.com.



1996 Sescom catalog

If you're into building, you can't do without this catalog. If you're not into building, you're missing a heck of a lot of fun. Building stuff is like going on a DXpedition; you never forget anything you've built—never. Old Uncle Wayne still remembers the very first radio he ever built, back 60 years ago. Not having a Sescom enclosure, he built it into a cigar box. And it worked! Now send for the catalog from Sescom, 2100 Ward Drive, Henderson NV 89015-4249; (800) 634-3457, FAX (800) 551-2749. Then let's see what you can build with the Sescom tools and enclosures.

Wanted ham-related articles to publish in 73. Contact Frances at 603-924-0058 for details.

Where Am I?

Here's how to find your grid square.

Arthur C. White
Route 2 Box 5600
Talihina OK 74571

Do you know the grid square of your location? If not, do you know how to find it? It's something that should be on your QSL card because, more and more, it is of interest to a lot of your fellow hams. This article offers a step–by–step procedure for finding your grid square.

The present system of grid squares was adopted at a conference held in Maidenhead, England (and is commonly called the Maidenhead system). By the mid-1980s it had become a worldwide standard. In this system, the entire world has been divided into (1) fields, (2) squares, and (3) subsquares. A particular location may be known as EM 24 KR—field, square, and subsquare, respectively. We'll get to each of them in turn.

Fields

These cover the entire world. Each field is 20° wide in longitude (or east-west) and 10° in latitude (north-south). Starting at 180° longitude (the international date line) and proceeding eastward, each 20° field is designated alphabetically all around the globe until arriving back at the date line again (**Fig. 1**).

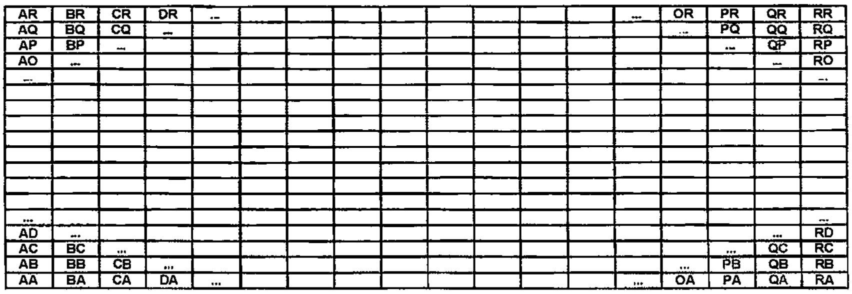


Fig. 2. North-south and east-west field designators are combined to create a two-letter designator for each 10° x 20° block on the face of the earth.

Since there are 360° in a circle, and since each field is 20° wide, there are 18 (360 ÷ 20 = 18) fields horizontally. Fields are designated with the 18 letters from A to R.

> ***"Given a longitude and a latitude, you can find your grid square location yourself."***

Similarly, starting at the South Pole and proceeding to the North Pole (a span of 180°), with each field occupying 10°, there are also 18 fields vertically (180 ÷ 10 = 18). These are also designated A to R (see **Fig. 1**).

So there are 324 (18 x 18) fields worldwide. All field designations start at the left and proceed to the right and then up. The longitude letter comes first, followed by the latitude, so that each field is specifically identified with a unique two-letter label. Your longitude and latitude at any place on earth determine the field you're in (see **Fig. 2**).

Of course, since the earth is round and the longitude lines converge at the poles, none of the fields is really square. They are wider on the side nearest the equator and narrower on the side nearer the pole.

Squares

Each field is divided into squares. A square is 2° in longitude and 1° in latitude. Hence, each field contains 10 squares (20 ÷ 2) in longitude and 10 (10 ÷ 1) in latitude, making 100 squares in all. Starting at the lower left corner, they are numbered from 0 to 9 towards the right, and 0 to 9 from south to north, again with longitude first (see **Fig. 3**).

Subsquares

Subsquares provide icing on the cake. To provide a higher degree of resolution, each square is divided into subsquares. Each longitude and latitude dimension is divided by 24, making 576 (24 x 24) subsquares. Since each square is 2° wide, 24 subsquares must each be 5' in

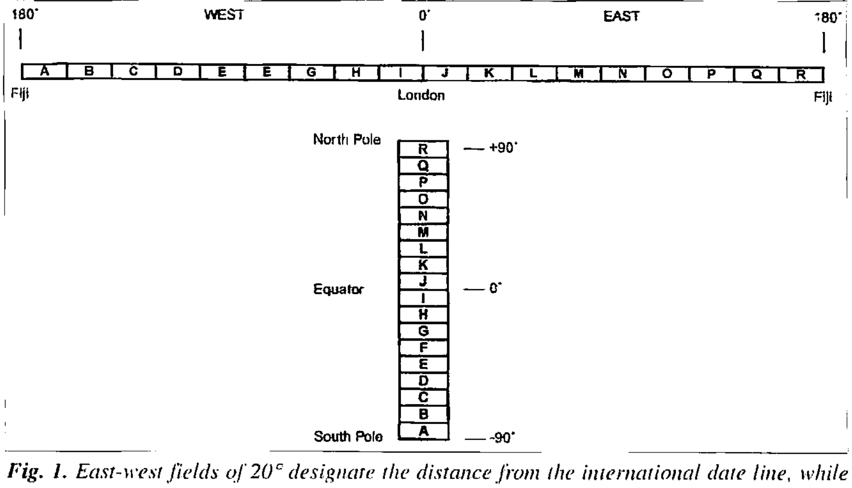


Fig. 1. East-west fields of 20° designate the distance from the international date line, while 10° north-south fields designate the location relative to the equator.

69	79	89	99
...	78	88	98
	...	87	97
		...	96
			95
			94
		...	93
	...	82	92
...	71	81	91
60	70	80	90

Fig. 3. Each field is divided into 100 squares, numbered from 00 in the southwest corner to 99 in the northeast corner.

longitude. Likewise, the 1° north-south distance of a square divided by 24 equals 2.5' in latitude. The subsquares are designated by letter, again starting at the lower left and proceeding to the right, and then from south to north, with longitude first. Hence, a location such as EM 24 KR designates a location on the surface of the earth within a 5' by 2.5' boundary. **Fig. 4** shows the western section of a square and the subsquare lettering system.

How to determine your location from scratch

The first thing is to know your longitude and latitude. Your library or a local surveyor may be a convenient source for this information. Say you're at 95°, 08', 55" west longitude and 34°, 43', 05" north latitude. We can simplify this to 95°, 08.9' west and 34°, 43.1' north (convert minutes and seconds to decimal minutes by dividing the seconds by 60 and rounding to the nearest tenth).

Let's begin by considering our longitude designators. We'll work eastward from the date line. First, determine how many fields you are removed from the date line. In this case, we are 180° – 95°, 08.9', or 84° 51.1' away (see **Fig. 5,** top).

AX	BX	CX	DX	...
AW	BW	CW	...	
AX	BV	...		
AU	...			
...				
...				
AD	...			
AC	BC	...		
AB	BB	CB	...	
AA	BA	CA	DA	...

Fig. 4. Each square is divided into 576 subsquares, designated AA in the lower left to XX in the upper right.

Note that if we were located in the Eastern Hemisphere, we would simply add 180° to our longitude to find our longitude distance from the date line. We have now established the first letter of our location: E. Since each field is 20° wide, 84° 51.1' puts us just past the fourth field (80°) and into the fifth.

Now, how far inside E are we? 84° 51.1' – 80° = 4° 51.1' so we are 4° 51.1' past the fourth field. Squares are 20° wide, so 4° 51.1' ÷ 2° = 2 with 51.1' remaining, so we are in the third square, which gives us the first digit in our square designator: 2 (see **Fig. 5,** middle).

Now we are 51.1' within square 2. Since the square is divided into 24 sections of 5' each, then 51.1' ÷ 5' = 10 + 1.1, so we are in the 11th sector. Our designator for the 11th subsquare, therefore, is K (**Fig. 5**, bottom).

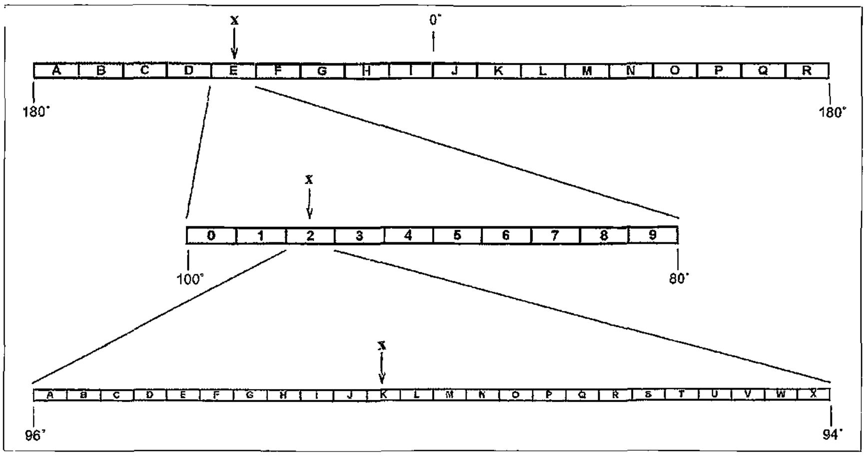


Fig. 5. The longitude portion of the grid square designator is found by locating the proper fields, square, and subsquare (top to bottom).

Now for the latitude indicators. Our latitude is 34°, 43.1' north. Starting from the South Pole, with a letter assigned to each 10°, we find we are in field M (**Fig. 6**, left). We are 4°, 43.1' north of 30° which places us in square 4 (**Fig. 6**, middle). And we are 43.1' north of 34° with 43.1' ÷ 2.5' being 17.24, so we are in the 18th subsquare above 34° which is R (see **Fig 6**, right). Combining our three latitude indicators with the previous longitude indicators (keeping the longitude first in each case) gives us the complete grid locator: EM 24 KR.

That's all there is to it. Given a longitude and latitude, you can "do it yourself." Try it.

Reference: The *ARRL World Grid Locator Atlas.*

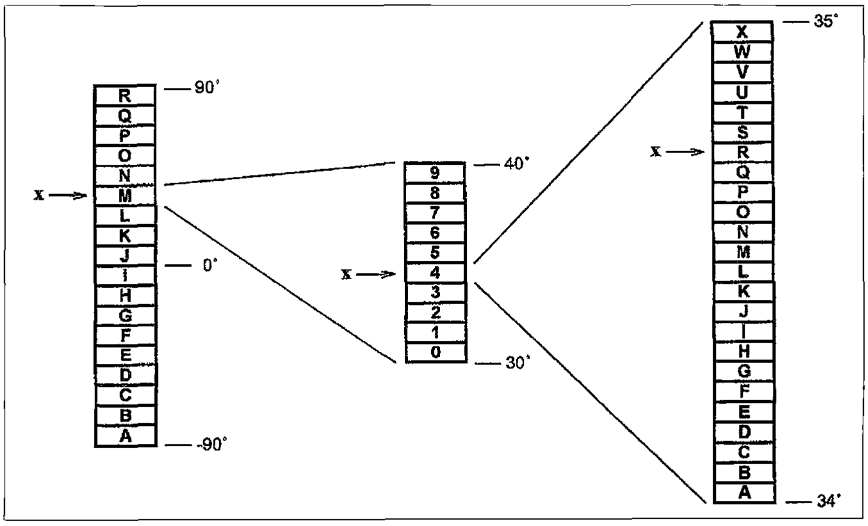


Fig. 6. The latitude portion of the grid square designator is found by locating the proper field, square, and subsquare (left to right).

Number 76 on your Feedback card

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The 73 Flea Market, Barter 'n' Buy, costs you peanuts (almost)--comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham sure it still works right and maybe you can help make a ham newcomer or retired old timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the August 1996 classified ad section is June 12, 1996.

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Wanted QSL Information from Phila Holmesburg Amateur Radio Club. Also wanted is information on the 15m Planetarium CW Net and for the following call signs: KA3IZF, AA3AW, SSV, KT4K, N2SFT, KW1C, PC5PKHT, KA1TQK, NA1TQK, K4CRF, KC4QMX, K4IVK, AA9JM, K4FLA, K8MTH, KC8BTE, KC5IWN,WYFR31M, K3EQ, AC4TYA, WA2PJF, K5TF, K4DX, WB4FFJ, K6CR, VE1TRH, CO3JY, W1CW, WZNUV, W8US, W9FF, W8AW/HCJB, W4AX, VCS, WCC, KA3LVN. Phone (215) 877-2665. BNB4002

NEVER SAY DIE

Continued from page 68

"If winds of tornado strength poured into the void left by the precipitating atmosphere, Coriolis forces would cause them to spiral about the pole in a counterclockwise direction—the same as the Earth's rotation—carrying considerable oceanic waters along the way. Further, the cumulative energy of the massed atmosphere would cause it to pile up at the pole and subsequently helically spiral upward into space.

"Does HAARP have the potential to generate such an electrical discharge? We don't know. But, if the means were at hand to make the sun go nova, there would be those who would be eager to make the attempt. This would automatically terminate the experiment, but this would be beside the point."

Maybe you can understand why the Alaskan legislature is beginning to get worried about the rapidly being built HAARP project in their back yard. I'm not worried. Amateur radio has provided me with a wonderful lifetime of adventure, so if some government-funded scientists blow the world to smithereens instead of investing the money in developing cold fusion as a low-cost source of pollution-free energy, big deal.

But maybe, if you tend to be a worry-wart, you'll want to read Begich's book and get a better handle on what's going on up there in Alaska. Or maybe you are comfortable, confident that the government knows what it is doing.

I Beg To Differ

Maybe you've noticed that we come in all sizes, shapes, colors, and temperaments. It's a problem for the clothing industry, which they haven't managed to cope with all that well. It's been less of a problem for our school system, which does its best to force all children, no matter their IQ or other characteristics, into a one-size-fits-all educational system. The fast get slowed. The slow get run over.

Our medical industry uses the same one-size-fits-all approach. For instance, there's one RDA, the recommended daily average dose of vitamins and minerals for people, no matter their size or shape, or any genetic differences in their body chemistry. Ditto immunization shots, and so on. Sumo wrestler or 97-pound weakling, everyone gets the same shots.

The fact that our genetic makeups are all different is one we can plainly see, with variations in skin color, height, body build, and so on. Does it make sense that we might just all be somewhat different chemically too? We know that we're all allergic to different things, right? Thus, maybe it stands to reason that our bodies are going to have somewhat different needs when it comes to vitamins and minerals and resistance to poisons. So should it be surprising when some people have violent reactions to some medications and shots? Some even die, but the number is acceptable to the medical profession. And the government.

Some people are more easily addicted to nicotine, alcohol, caffeine, and other drugs than others. And a few of our soldiers got sick (some died) from the barrage of immunization shots they got on their way to the Gulf War. Acceptable losses, no doubt. And the fluoride put in our drinking water kills a few people. Tough. Our water supplies are 60% fluoridated. Those in Europe are under 2%. Obviously they're a backward people. I'm sure it's a coincidence that fluoride is used on animals to make them more docile and we're seeing similar side effects with our people in cities with fluoridated water.

But books have already been written on these subjects, complete with references to research reports. So read the books first and then argue with the authors. I don't want to turn my editorial into an in-depth report on things that books cover much more thoroughly. I just want to wave the red flag and point you toward learning more and not docilely accepting what our caring government, and the big money industries which guide and drive it, do to you.

Crankcase Sanding

Mother Nature (aka God) spent several million years developing our mind/bodies into an incredibly intricate system. It has evolved perfectly adapted to the environment, designed to perform optimally on the food, water, air, and sunlight that was available during this development period. Does that make sense?

The more I read and listen to people who've spent years studying health and longevity, the more convinced I am that if we were to provide our bodies with the same food and water it was designed to handle, it would last at least double the mileage we're getting out of it now. We're putting sand in our crankcase, sugar in our gas tank, sludge in the radiator, and throwing garbage in the back seat of the fantastic limo we were issued at birth.

Let me put this another way. How much would you be willing to pay right now to get one more week of life 20 years from now? A buck? A hundred? A thousand? Okay, what would you pay to put off dying today until a week from today? Every nickel you have or could borrow, right? You might want to sit back and think about that. Put it into perspective. How important is next week for you? Next year? Ten years from now?

Does the prospect of being able to live healthily until you are 150 seem at all attractive? Yes, there are men over a hundred who are still fathering children and who are probably a whole lot healthier than you are right now.

Is this important enough for you to make an effort to learn more about your health and what you're doing every day to ruin the fine machine you were issued at birth?

Tomorrow

Tomorrow I'll start eating healthier food. Tomorrow I'll start taking those walks. Tomorrow I'll get some sun. Tomorrow I'll read that book Wayne recommended. Next week I'll start that small business I've been thinking about. Next week I'll get started toward upgrading my

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UPDATES

Which switch is which?

In the May issue, '96, we mislabeled a switch in each of J. Frank Brumbaugh's schematics. First, in "Simple Multi-use Amplified Speaker," on page 41, the switch that's connected to BT1 should be labeled S1. Then, in "Antenna Noise Bridge Detector," on page 78, the switch that is labeled S1 and connected to BT1 in the upper right of the schematic should be S2.

It's alive!

In May's *73*, "How to Make an Old HW-8 Come Alive" appeared on page 42; author Gerald Gronson K8MKB has alerted us to a few changes that should have been made.

Resistors Rb and Rc: 33,000Ω. Ra: 1Meg. R27 is between 3.3 Meg and 2.2 Meg. Try 3.3 Meg; if, with the volume control wide open, the receiver breaks into oscillation, replace it with the next-lower 5% value (a larger R27 resistor makes for higher gain in the IC2C stage, however). R205 can be 1.5k (whatever is on hand).

In Fig. 2, the capacitor labeled "C" can be anywhere from 1μF to 5μF tantalum or electrolytic, 15V unit (μF value not critical). C38's only change is to 4.7μF (or 5μF—it doesn't matter; whatever capacitors are on hand—all 4.7μF or 5μF are OK). C31 should read .1μF to .05μF.

ticket. Next month I'll buy that new rig. Next year I'll go on that DXpedition.

Blue collar jobs are moving to lower wage, higher automated countries. White collar jobs are being replaced by computers and better communications systems. Upper management jobs are being downsized. Pensions are an endangered species, except for government workers.

A generation or so ago you used to be able to pretty much count on retiring at 65 with a gold watch and a nice pension. Then the big corporations figured out that it was a whole lot cheaper to get rid of upper management people by bumping them out before the generous pensions kicked in. That cut down on their long-term liabilities, making their stock more desirable.

Now, many of us are forced to face that tomorrow when, in our 50s, suddenly we may be laid off. Fired. Canned. Talk about a mid-life crisis! You're too old to be of any real interest to another large company. You never put much aside, preferring to enjoy a nice home, an expensive car, and lots of toys to planning about tomorrow, so even if you had a small business in mind to start, you haven't the savings cushion to do it. So what do you do?

Our Blind Media

Thanks Mike Browsher K8HQQ for a clipping from *Media Bypass Magazine* on the decision "not to run" by 45 members of Congress. Other than an "oh my" or two, I haven't seen much in the media about this wholesale evacuation of DC.

The article asks why all these politicians are willingly giving up their seats of power and endless money. Their answer is that a small group of computer hackers (called the Fifth Column), formerly with US intelligence agencies, have been tracing the secret foreign bank accounts of our politicians and in many cases repatriating billions of their dollars to the Treasury. Each of the "not running" or "retiring" officials has, according to the article, been handed a detailed report of their Swiss bank transactions. The options: retire immediately or face widespread distribution of the information, including the IRS.

There are a thousand ways for officials to sidetrack re-election funds, honorarium, bribes, lobbyist donations, and so on. Politics can be a ver-r-ry lucrative career path. A threat to investigate the liquor industry brings in massive bribes to stop that nonsense. Ditto every other controlled industry. And most of our larger industries are controlled by a small group of men. I remember when Senator Dodd of Connecticut got caught pulling this extortion.

When I got involved with the music industry I found it totally controlled, from performers to record stores, by seven mega-corporations, six foreign-owned. They controlled record store distribution, radio airplay, juke boxes, and so on. Fewer than 5% of their performers ever made a nickel in royalties due to bookkeeping practices similar to those in the movie industry. And so it went.

The magazine distribution industry is even worse. Ditto the medical industry, the education industry, and so on.

If you think I am exaggerating and have any facts to support it, please let me know. I've done my homework on this pretty carefully. More likely, you'll tell me about the corruption in the industry you're involved with.

Doctors

Like you, I was brought up to look on doctors as experts I should turn to when I get sick. It's been difficult for me to get over that early programming. And probably, despite my editorial educational efforts, I've failed to shake your belief in their expertise. The sad fact is that doctors are in a fix. It costs a fortune and years to get the license to kill, and they have to go through the warping experience of medical school, where the curriculum is controlled by earlier experts. And this whole works is solidly in the hands of the pharmaceutical industry, supported by the FDA, NIH, and WHO. And they're kept in control via Congress and millions of dollars from lobbyists.

So we have spectacles like the continuing resistance to the low-cost cure for ulcers. And all this AIDS nonsense, which is a billion-dollar industry. Duesbery has a new book, *Inventing the AIDS Virus*, which I haven't read yet. I did read his earlier book on the subject, and this one further confirms his claims that the HIV virus is not the cause of AIDS. I've recommended the similar book by Dr. William Douglass of *Second Opinion*, which claims that AIDS was developed and spread on purpose by the World Health Organization.

AIDS is a billion-dollar industry, so the worst fear of those in the business is a cheap, simple cure. This is why the Beck approach has been resisted so strongly by the AMA, FDA, and AIDS researchers and workers, despite the credentials of the Albert Einstein College of Medicine and 15 patents for the process being issued to hospitals.

Have you read *Racketeering In Medicine* by Dr. Carter, which is on my list of books you're crazy if you don't read (my list is $5 from Radio Bookshop)? I've added *Dirty Medicine* by Martin Walker, a 733-page thoroughly documented indictment of the medical industry, to my list on the latest update. Slingshot Publications (London), ISBN 0-9519646-0-7 ($24).

The sorry fact is that if you have any interest in living long enough to get your Social Security taxes back, and living it in good health, you've got to do your homework, because the doctors you've been trusting haven't. They're generally busy dealing out prescriptions for drugs and operating to repair the mischief they and you've done to your body through negligence. Like lousy food, polluted water and air, a lack of needed minerals, immunization shots, and so on.

Yeah, I suppose I may come across as a health nut. Well, there are a lot of 'em out there who've been caught up in vegetarianism, macrobiotic diets, fasting, popping handfuls of vitamins, and so on. I like to see ideas supported by common sense and by a number of different researchers so I don't buy into some kind of nincompoopery. And, since I'm almost to the age when half of my compatriots are already dead, it's probably about time that I started paying more attention to the maintenance of my body.

Of course, if you don't mind annoyances like cataracts, Alzheimer's, allergies, arthritis, diabetes, herpes, osteoporosis, heart attacks, high blood pressure, and so on, hey, it's your body, and from what I've been reading in books recommended by your fellow readers, none of this is necessary or unavoidable. It's not God or chance that's rolling the dice, it's you.

Mamiya RB-67 Wanted!

The best equipment photo camera I ever had was the old Mamiya RB-67. Then my staff photographer swiped it when she quit. Ouch! But how do I prove it? I've been making do with my 35 mm Nikon, but I'd like to replace my old RB-67, which has a 6 cm x 7 cm negative, and therefore makes the sharper pictures needed for magazine use. The problem is that I'm thrifty (NSD = never spend a dollar), so I'd like to hear from any reader in the camera business who might be able to find an old used RB-67 for me at the wholesale price. Camera, back, and a 127mm or so lens. Maybe a macro lens?

Really Bugged

I've been living in NH for 34 years now and I've never seen anything like the ladybug infestation we had this spring. I was amazed last fall when I was out in the yard pulling dandelions one day and I was almost covered by ladybugs. Then, all through March and April, the windows on the west side of the house were crawling with them in the afternoons.

Everyone knows that ladybugs are good, so I was surprised to find that they bite. Ouch! Hmm, so I started collecting them as they managed to somehow crawl inside my windows and take them downstairs to our dining room mini-rain forest. Well, big deal, eh? Hey, I'm talking 100-500 bugs some days! Inside. Never in all the years I've lived here can I recall seeing even one ladybug coming inside like that.

I visited a chap who lives about 20 miles from here and one of his windows was swarming with ladybugs too. What's going on?

The X Files

While I enjoy the Fox™ program of the same name, in this case it has to do with transmutation. X, as in x-former or x-mit. Well, we use "x" for xtal...meaning crys, perhaps short for cross. With the cold fusion research going more and more into the transmutation of elements as an explanation for the excess heat being developed, I've been keeping my eyes open for anything relevant. I've written about

this recently, so I won't go over it again.

Anyway, when I read about a transmutation experience in René's *The Last Skeptic of Science* book, I quickly rattled René's cage for more details. The experiment described in the book was his and Pete Ross's effort to whip up some small diamonds out of carbon.

Back in 1977 they made a furnace out of a 25-gallon steel drum, which was split in half lengthwise and laid on its side. They lined it with lime as a refractory material. They set up two long 3" diameter carbon rods for the arc and powered them with a large electric arc welding machine. They loaded the arc area with calcium carbide and turned on the power.

Once the arc got going, the rods were pulled back and the arc was able to continue, but it was only drawing 260 watts, while the heat being generated was more in the thousands of watts range. The following day, the pot started growing into a baby volcano, percolating up hot viscous material, much like a volcano's lava. Concerned, Pete lowered the power to slow the growth. It didn't slow, so he poked the bubbling mound with a half-inch steel rod. It instantly vaporized at least a half inch of the rod, shooting a blue-white light beam toward the roof of the old warehouse where they were working. Pete quickly shut off all power, yet the volcano continued to grow.

To stop the runaway volcano Pete broke open its walls and poured in more calcium carbide. This stopped the reaction.

The bad news was that when they sorted through the remains, the few tiny diamonds they found were of a poor quality and worth less than the current consumed making them. The good news (for scientists willing to pay attention) was the anomaly of finding higher atomic weight elements. Nothing with an atomic weight over 20 went into the mix, and elements up to 83 (bismuth, which is heavier than lead, and is as high as you can go without getting into the radioactive elements) resulted. They found a lot of iron ($_{26}Fe$), which could be calcium ($_{20}Ca$) plus carbon ($_{6}C$).

They tried for several years to get universities to redo the experiment and confirm the transmutation products. But since the transmutation of elements is "impossible," they could find none that would even try. I asked René what happened to Pete and he said that Pete had gotten interested in computers, had hacked his way into the CIA computers, and shortly after suddenly disappeared one day and nobody, including his family, has ever seen or heard from him since.

If you decide to try this, be sure to have plenty of room around for accidents. René says to have the electrodes spring-loaded so they can be pulled apart quickly when things start to take off by themselves. And remember that virtually all of the major breakthroughs in science have been made by amateurs who didn't know that it couldn't be done. Remember, too, that few of the beliefs in physics 50 years ago are still believed today. I'll bet the same will be said 50 years from now.

René's *Last Skeptic* book is available exclusively from Radio Bookshop. It's $25 + $5 s/h. It will keep you armed with interesting things to talk about for weeks.

A Little Late

Vern Hargreaves K4HMV just sent me a QSL, for which my thanks. It was for a 1948 2m contact. I hope Vern isn't as far behind with everyone else. Vern is not only still active, he's also a subscriber and contributor to my *Cold Fusion* magazine, plus an early experimenter with the Beck blood purifier circuit.

That reminded me that the 50th anniversary of our return to the air after WWII went by without any special notice. Since I was teaching radio at the New London (CT) Submarine Base at the time, I was able to get on the air the day they opened 2-1/2 meters with a radio in my lab. That weekend I brought my pre-war walkie-talkie up from Brooklyn. It had a 1G4GT oscillator with a 1Q5GT modulator and superregen receiver. I made contacts from a hill on the sub base evenings. Then they opened 10m, and I got on there the first day the band opened. One of my first contacts on 10m was Ed Ricca W2OCL (now K4PT).

Thanks Vern, for the QSL.

McDonald's

A reader sent me a McDonald's place mat extolling the importance of immunization and giving the ages at which children should be given shots, citing the National Medical Association and the National Council of La Raza, whatever they are. Are they fronts funded by the pharmaceutical companies? I sure hope you do your homework on this one and at least read *Immunization, The Reality Behind the Myth*, by Walene James. It's on my $5 list of "Books You're Crazy if You Don't Read." If this book doesn't turn you into a religious fanatic opposed to immunization, let me know.

We spend 30-40% more on "health care" than any other country in the world, yet we have 40 million people with arthritis (a nutritional disease), 15 million with asthma, and over a million new cancer cases annually, of which half will be fatal. And the situation is getting worse, not better! Heck, according to a Nader report, over 300,000 people die a year just due to mistakes in hospitals.

Until mass immunization of our kids came along, autism was virtually unknown, as were dyslexia, learning disabilities, and hyperactivity. Now we have millions of hyperactive kids, so we drug them with tranquilizers, frying their brains, and wonder why the SAT scores have been plummeting. No problem, they just lowered the scale.

What can *you* do about it? Well, if one 13-year-old kid can make a worldwide fuss over child labor, complete with an interview on *60 Minutes*, you too can move mountains. Arm yourself with the facts and then get busy. One way to have a good chance at being able to change things is to run for your state legislature. That will give you access to the media, and an opportunity to make a difference.

Or have your brains been fried too?

ABOVE & BEYOND

Continued from page 71

communicate with must also use the same frequency range (IF) to receive on. It doesn't matter what frequency you select—just tune the FM radio to a quiet place on the dial, say the lowest frequency, 88 MHz. The modulator must still be used as is. Of course, the frequencies on 10 GHz will now be 88 MHz apart instead of 30 MHz, as with the PC board unit. Now this is a simple project; I hope you enjoy simple microwave operation.

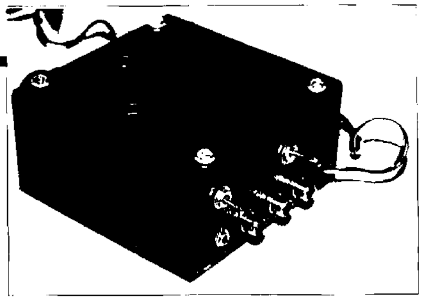
Well, that's it for this month. Next month I will cover some additional test circuits to add pleasure, smooth methods, and test procedures for microwave operation. One of them is the microwave reflection antenna using the 30 MHz TTL oscillator. For questions, drop me a line on the Internet at clhough@aol.com, or send an SASE to the address at the beginning of this column.

73 Chuck WB6IGP.

73 Review

CMOS Super Keyer 3

"State-of-the-Art Keyer Kit is a Bargain!"



Marshall G. Emm AAØXI/VK5FN
2460 S. Moline Way
Aurora CO 80014

It's probably a sign of the times, but when it comes to Morse keyers and keyer kits, there isn't a whole lot to choose from. There are lots of "basic" iambic keyers based on the Curtis 8044ABM chip or an imitator, starting at around the $20 mark. Then there are the all-the-bells-and-whistles memory keyers, which start at around $100 and go well above that figure. So it was a pleasant surprise to find a memory keyer available as a board kit for a mere $58 postpaid.

The CMOS Super Keyer 3, available as a board kit from Idiom Press, is a full-featured keyer, with a substantial amount of memory (1530 characters) configured as either 6 or 18 separate messages, and enough functions and features to fill a couple of books; for example, the tutorial and operating guide that comes with the kit. It does just about everything you can think of, and the price is substantially below that of any other memory keyer or kit presently available.

The features of this keyer are too numerous to describe individually. There are twenty listed features on the first page of the manual, which include burst sending to 990 wpm, contest serial numbering, and full beacon capability. There are 19 function commands, 18 inquiry functions, 11 programming functions which can be embedded in stored message text, and 7 two-button direct commands.

Some features that I found to be of particular interest:

You use Morse to communicate with the keyer. Commands are sent from the paddle, and the keyer responds, in Morse, via the speaker!

All settings and the contents of the memories are stored in NV RAM, which is permanent and does not require a battery or power connection.

Power consumption is extremely low, typically 20 mA key-down and 10 µA when idle, so it is perfect for battery operation in emergency conditions.

"It's probably fair to say that the CMOS Super Keyer 3 is the most feature-rich and flexible keyer on the market."

You can select any of ten different keyer emulations so the CMOS 3 will work just like the keyer you are used to.

It's probably fair to say that the CMOS Super Keyer 3 is the most feature-rich and flexible keyer on the market, but there is a catch, or two....

First, when Idiom says "board kit" they mean exactly that. You get the circuit board, the board-mounted components, and the tutorial/operating book. That's it. Figure another $20 or so for hardware: a box, six push button switches, a pot for speed selection, speaker, and jacks for paddle and key line. I added a straight key jack, and a second keyed line with a switch so that I can key rig a, rig b, or both. I also added an LED, a type 7805 voltage regulator (RS276-1770), and a manual tune switch.

Second, although the CMOS 3's antecedents have been around a long time (the CMOS II was described as a project in the ARRL Handbook from 1992-1995), it's not like buying an ordinary kit, exactly. Version 3 was announced and described in the August issue of *QST,* and shown on the magazine's cover as a "weekend project," but you couldn't build it from the article; there is only one supplier of the board and the programmed chip. So in this reviewer's opinion, the article should have been labeled as a product announcement and not a project, but that is, of course, a criticism of *QST,* not the keyer.

The "kit" from Idiom does not include any construction information or instructions. There is an oblique reference to a "construction article" which turns out to be the article in the ARRL Handbook (in accordance with Murphy, I have the '91 and '96 Handbooks). In subsequent correspondence, Idiom has promised to include at least minimal construction information.

Construction

Building the CMOS 3 is relatively straightforward— it's a matter of populating the circuit board and making the connections. Without any instructions, you will need to consult the circuit diagram (in the center of the manual) to identify component values. There are only two issues which may require clarification. You can probably deduce both of them, but I have found that it is generally not advisable to make any assumptions when building a complex kit!

1. The orientation of the resonator Y1 doesn't matter; it can go in either way.

2. Some external wiring uses a shared ground return connection (e.g. the switches), while other components have labeled connections for both wires.

You will need to be very careful with the soldering. The CPU chip socket has 38 pins, and the tracks on one side of it are the closest I have ever seen. You will need a very light soldering iron with a fine tip. I soldered under a large magnifying glass, pausing frequently to check my work with a 10x loupe.

Since both ICs (the CPU and memory) are CMOS devices, they are extremely sensitive to static electricity. Handle them no more than absolutely necessary, and it is a good idea to ground yourself whenever you are working with them. A ground wire with an alligator clip attached to your metal watch band or a finger ring is fine. Before you insert the chips in their sockets, connect the negative power supply lead first and ground it.

RFI Problem

The CMOS 3's CPU is a computer, and, like all such devices, it generates RF hash which is audible across the HF spectrum. Without shielding, the level is high enough to cause problems with reception, and makes QSK (break-in) operation impossible. Note that the hash is generated only when the processor is working, i.e. when you key it, send a command or inquiry, or send from memory. If you use the beacon mode to send CQ, the hash will be generated during the pause between calls, so you should do everything possible to minimize it.

You can add bypass capacitors to all external connections, and, as suggested in the *QST* article, you will want to install the keyer in a metal box. Indeed, one of the authors made the illustrated box from copper-clad PC board material. Finally, use shielded (e.g. audio) cable to connect your paddle and your rig.

I did all of the above (using a steel box in place of a copper one), and still have a problem. Next step will be to "deconstruct" the keyer and place ferrite beads on all wires connected to the circuit board. As it stands, the level of RFI is just a nuisance and not a critical problem.

Operation

The CMOS Super Keyer 3 is a joy to operate. There are a lot of functions and commands, but they are generally mnemonic and therefore easier to use than the digital codes common on "keypad" keyers. For example, you put the keyer into inquiry mode and send "S" to have it report the currently selected sending speed.

The keyer has three operating modes:

Direct Sending mode. Whatever you send with the paddle is processed and used to key the transmitter directly.

Command mode. Pressing one or more buttons causes the keyer to send from memory or carry out programmed or keyed instructions. For example, pressing button 1 causes the keyer to send the contents of memory register one. Simultaneously pressing buttons one and two puts the keyer into keyed-command mode, and you use your paddle to send the relevant function command.

Inquiry mode. Simultaneously pressing buttons five and six puts the keyer into inquiry mode. Paddle an inquiry command and the keyer will respond by "sending" the current setting.

In both command and inquiry modes you will receive feedback in Morse from the speaker, and you can set a different speed for this type of communication than the sending speed. Communication between the user and the keyer is handled "off-line," without keying the rig.

The designers, KCØQ and NØII, are amenable to suggestions; indeed the *QST* article says that Version 3 arose largely from user feedback. There are some things I'd like to see in a software upgrade, and in the context of a review it should be noted that these are things that are missing in Version 3:

A function to set an absolute speed in wpm. As currently programmed, you can achieve the same effect by specifying a range with the same figure entered for both upper and lower limits, but this is clumsy and requires a second command in order to make any speed change later (the speed pot is "disengaged").

"You can build the CMOS Super Keyer 3 in about three hours."

Have a paddle-touch terminate memory sending without keying the paddled element. Some keyers work one way, some the other, so perhaps this could be a user-selectable option.

Offer "bug mode" as one of the emulations, i.e. have the dit paddle send dits, but the dash paddle in "straight key" mode.

A function to copy the contents of one memory location into another. This would allow for easier building of complex messages with repetitive text.

An ability to edit a message from the first word, and/or an ability to insert text into an existing message.

Conclusion

If you have good soldering skills, you can build the CMOS Super Keyer 3 in about three hours, depending on how you handle the hardware options. The result will be a keyer that is every bit as good as any keyer you can buy, with the advantage of relatively low cost.

Availability

The CMOS Super Keyer 3 kit, comprising circuit board and all board-mounted components, is available by mail order only from Idiom Press, P.O. Box 1025, Geyserville CA 95441 (916) 857-3524.

Ham Shack Test Equipment

Continued from page 10

SWR analyzer

This commercial instrument is invaluable for measuring antennas, as well as at the end of the feeders in the shack. It also enables you to determine antenna tuner control settings without putting the transmitter on the air and generating QRM.

Several manufacturers offer different models, for HF as well as VHF and UHF. Many include an LCD readout of the frequency of the internal oscillator, and can be pressed into service as frequency counters over their ranges, although most require a fairly substantial input signal. Some also measure radiation resistance at the feed point.

Some, possibly all, can be used as a dip oscillator to check the resonant frequency of tuned circuits, and the value of either L or C if one or the other's value is known accurately. MFJ offers an adapter, primarily a coil of wire wound on a form, for several models of their analyzers, allowing them to be used as accurate dip oscillators.

Although the tuned oscillator in these analyzers is not especially stable, it can be used as a signal generator. The output of most analyzers is relatively high; the RF voltage approaches 1 volt RMS no load at 160 meters, and a bit less as the frequency is increased. You should use an attenuator if you're feeding the antenna input of a receiver directly, or stick a wire in the central output terminal and radiate a signal to the receiver.

In general, prices begin just under $100 and go up. Look at what is available, considering the bands you normally work or plan to work, and choose the best analyzer you can afford. An SWR analyzer is strongly recommended as an invaluable addition to your shack.

Field strength meter

A small field strength meter sitting at your operating position will continuously monitor the power radiated from your antenna, when it isn't being used to check the radiation pattern, front-to-back ratio, and major lobe width of your beam. The ham literature is filled with many different designs for various types of field strength meters, and home-brewing is the cheapest way to go.

A short vertical whip or piece of stiff wire feeding a voltage doubler, consisting of a pair of germanium diodes bypassed by a 0.01 µF disc capacitor, into a 10k ohm pot with a microammeter from wiper to ground will be adequate for most ham stations.

Should you require accuracy instead of relative measurements, the *ARRL Handbook* has had a suitable design for several years. Commercial (and extremely expensive) accurate instruments with digital readout are available from several manufacturers who advertise in ham magazines.

Frequency

Accurate frequency measurement is necessary when aligning receivers, checking band edges, calibrating analog dials on home-brew receivers, VFOs and some test equipment, and in many other situations.

The simplest and cheapest way is to build a secondary frequency standard (crystal marker generator). A unit based on a digital oscillator using a 74LS00 and a 10 MHz surplus microprocessor crystal, followed by a few 74LS90 decade dividers and a 74LS74 dual flip-flop, will produce known, stable frequencies of 1 MHz, 100 kHz, 50 kHz, 25 kHz and 10 kHz, with harmonics well into the VHF range. The 10 MHz oscillator must be set on frequency either with a frequency counter or by zero beating against WWV during the seven-second period every minute when the carrier is not tone modulated. The cost of the marker generator should not exceed $10, though it can be zero if you have a well-filled junk box or know someone who does.

A much handier (and highly recommended) step up is to purchase a commercial frequency counter. A great many are available, covering different frequency ranges and having differing sensitivities at various prices, some of which are rather high.

If you are interested in microwaves, you will want a counter capable of making measurements in the gigahertz range. If you usually operate HF, VHF, or UHF through the 70 cm band (this includes the majority of hams), my personal recommendation is the Ramsey CT-90 frequency counter. It covers 10 Hz to 600 MHz with a nine-digit LED readout and three gate periods: 0.1, 1, and 10 seconds. Sensitivity is less than 10 mV from 10 Hz to 150 MHz, and less than 150 mV up to 600 MHz. Constructed in the standard small Ramsey cabinet, about 5" x 5" x 1-1/2" high, it can be powered by 12 volts AC or DC, or by four AA NiCd internal batteries which are kept charged whenever the supplied wall transformer is in use. Ramsey offers two probes, one for 10 Hz to 20 kHz and the other from there to 600 MHz, but you can easily build your own for a very few dollars. The advertised price for the CT-90 is $169.95. (Ramsey Electronics Inc., 793 Canning Parkway, Victor NY 11454; (716) 924-4560).

Although I use the Ramsey and recommend it highly (I operate only 40 through 10 meters), there are a number of manufacturers offering frequency counters and you should investigate them all, depending upon your own special needs. Compare specifications and prices, and then choose the best instrument for the money.

Inductance

The chances are that unless you do a lot of experimenting and building VFOs, receivers, etc., you won't need to measure many small inductances. However, for home-brewers and QRP enthusiasts who do need to know the value of small coils (20 µH or less), there are several choices.

Commercial LCR meters, which look much like DMMs, are widely available from many manufacturers at fairly high prices. Buying one if you already have a full-function DMM is overkill. Other much more expensive inductance bridges are available commercially, but most hams can't afford them and don't need them. Occasionally a "boat anchor" such as the superb Boonton Q-Meter becomes available on the surplus market, but at a fairly high price.

Another choice is to build your own. The 1995 *ARRL Handbook* describes a multi-range inductance bridge. Several ranges are beyond those of interest to most home-brewers, but they might come in handy someday.

My personal recommendation is one that I designed and used (see "The Handy Inductance Bridge," *73 Amateur Radio Today*, May 1991, page 11). I have since modified the RF generator, eliminating the two transistors and substituting a 74LS00 crystal oscillator.

For a simpler, cheaper inductance meter, please see: "A Simple Inductance Meter," *73 Amateur Radio Today*, June 1996. This is not a bridge and uses an entirely different means of measuring inductance, eliminating the need for a zero-center meter which the instrument in the 1991 reference requires.

Capacitance

In case your DMM does not measure capacitance, you can construct a simple, accurate instrument for less than $5.00. Please see "A Simple Capacity Meter," *73 Amateur Radio Today*, March 1996, page 71.

Audio frequency generator

A stable, known frequency source of clean audio between 300 and 3,000 Hz is necessary when checking audio circuits, and is invaluable when designing and building active and passive audio filters, and when setting the center frequency of SCAF filters. The frequency must be variable, and so must its level; this eliminates small, fixed-frequency oscillators. Commercial audio generators covering several wide frequency ranges are available. Not only are they large and costly, but they also have much broader capabilities than the 300-3,000 Hz most hams need. A much cheaper and far more stable and accurate option is to build your own (see "Crystal-Controlled Audio Generator," *73 Amateur Radio Today*, November 1995, page 28. Note: There is an error in the schematic; C11 should connect between the Q3 emitter and the Q2 emitter.) This simple instrument covers the 300-3,000 Hz range when calibrated. The parts cost should not exceed $10. The stability and accuracy will be that of the crystals used.

Multiple voltage module

It is true that "you can't have too many power supplies." However, power supplies are bulky, costly, hot and, unless needed most of the time, represent a waste of dollars. However, it is often necessary to provide a fixed voltage to a circuit being designed or a piece of equipment being tested or serviced. Most of the time the needed voltage will be other than that supplied by the station power supply. A common example is the +5 volts required by TTL digital circuits, or the 6 or 9 volts needed to power a portable radio you're working on.

The home-brew answer is cheap and simple. Mount 7805, 7806, 7808 and 7809 regulators in a small aluminum box (which also serves as a heat sink for the regulators). Mount at least two RCA jacks for each voltage output. Feed the box with 13.8 VDC from your station supply. Bypass the DC line where it enters the box with both a 0.001 µF and a 0.1 µF capacitor. Use the same values of capacitance to bypass each pair of voltage output jacks.

To make this unit even more versatile, connect a 317T variable regulator and a 5k pot and another RCA output jack (remember to bypass it) and you'll also have an ampere at about 2 to 12 volts DC. Don't forget to insulate the tab of the 317T from the case.

Oscilloscope

Of all the items of test equipment helpful to hams, the 'scope is the most useful and versatile. However, they are large, generally heavy, and always expensive; not every ham can afford one. But, if your budget will stretch that far, a good wideband oscilloscope will be most useful.

For the ham who operates primarily in the HF bands, a 'scope with a 50 MHz bandwidth will do a fine job, although a 100 MHz bandwidth would be even better. It should be a dual-trace 'scope. Occasionally such a 'scope appears on the surplus market, at a price starting around $350. Such 'scopes were built by companies like Hewlett-Packard, Tektronix, etc., for the military. All of these are solid state (except for the CRT) and dual-trace. Most have a 100 MHz frame, but many will have 50 MHz. Those built for the Navy cost the taxpayers $3,300 each, and they are "built like a battleship" and almost as heavy. If you can afford $350-$400 or so and can find one, grab it!

Some rather large and heavy vacuum tube-type Tektronix 'scopes in their 500 series are usually available from outlets such as Fair Radio Sales, Inc. in Lima, Ohio, but I do not recommend buying even a bargain 'scope which is from the vacuum tube era. Tubes have become scarce and expensive. This supplier, as well as Tucker, often have other suitable surplus 'scopes. Get their catalogs and keep checking ads. To my knowledge, for you microwave buffs, oscilloscopes with a bandwidth of 3,000 MHz are available but their cost is prohibitive.

About the only other option is to locate a good, recent Heathkit® 'scope with a 5 or 10 MHz or more bandwidth at a hamfest, and if it works and the price is right, buy it. Then build the HF adapter described in the *ARRL Handbook*, adjusting its oscillator frequency as required. This will allow you to see a high frequency signal on a low frequency 'scope, and the overall cost will be much less.

A personal note

I own and use everything I have discussed here-except an oscilloscope. Would anyone like to donate one to me (ha!)? 73

Number 84 on your Feedback card

Special Events

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the April issue, we should receive it by January 31. Provide a clear, concise summary of the essential details about your Special Event.

JUL 5–6

PASCAGOULA, MS The Jackson County ARC will hold its 2nd annual Hamfest in the Pascagoula MS Civic Center, located on the Jackson County Fairgrounds. Talk-in will be on the W5WA Rptr. 1700–2100 hrs July 5th, and 0800–1500 hrs July 6th; 145.110(-); alternate 146.880. Nearby hotels and motels at reasonable prices. For tables and flea market reservations, contact *"Kim" Kimmerly N5XGI, Hamfest Chairman, 19000 Busby Rd., Vancleave MS 39565. Tel. (601) 826-5811.* For VE Exams, starting at 0900 Sat., July 6th, contact *Bob Pierson N7NE, 1216 Hickory Hill Dr., Gautier MS 39553. Tel. (601) 497-3096.*

JUL 6

MILTON, ONTARIO, CANADA The 22nd annual Ontario Hamfest, sponsored by the Burlington ARC, will be held at Milton Fairgrounds starting at 9 AM (Thomas St. gate only). Tailgaters at 8 AM (Robert St. gate only). Set up at 7 AM for commercial vendors (Robert St. gate only). C.L.A.R.A. annual Picnic Meeting at 11:30 AM. For more details, contact *Burlington ARC, P.O. Box 85037, Burlington Ont. L7R 4K3, Canada;* or contact *Norm VE3CZI at (905) 335-8962; or Packet: VE3CZI@VE3DTV.*

PETOSKEY, MI A Hamfest and Swap/Shop will be sponsored by Straits Area ARC, 8 AM–1 PM at the 4-H Building, US-31, 2 blocks west of US-131 intersection. Talk-in on 146.68/.52. Commercial displays will also be featured. Contact *Harry N8OIV, (616) 347-7771.*

SALISBURY, NC The North Carolina Alligators Group "Firecracker Hamfest" will be held at Salisbury Civic Center, 8 AM–1 PM. An Auction will be held at 1 PM. Setup Fri. 3 PM–9 PM; or Sat. at 7 AM. Contact *Walter Bastow N4KVF, 3045 High Rock Rd., Gold Hill NC 28071. Tel. (704) 279-3391 until June 28, then (803) 266-7900. Talk-in on 146.730.*

JUL 7

LISBON, OH The Triangle ARC will sponsor a Hamfest at Columbiana County Fairgrounds 8 AM–3 PM. Talk-in on 146.70/.805. Contact Dick Sisley K8JKB, 1218 Northside Ave., East Liverpool OH 43920. Tel. (330) 385-1245.

JUL 12–14

DUNSEITH, ND The Internat'l Peace Garden Hamfest Committee will host a Hamfest at Internat'l Peace Gardens, North of Dunseith. Transmitter Hunts, Mobile Judging, Camping. Talk-in on 146.85/.52. Contact *Dave Snydai, 25 Queens Crescent, Brandon MB, Canada R7B 1G1; or John Engel WAØLPV; 616 8th St. SE, East Grand Forks MN 56721.*

JUL 13

OAK CREEK, WI The South Milwaukee ARC Inc. will hold its 27th annual "Swapfest" at the American Legion Post #434 grounds at 9327 S. Shepard Ave., 7 AM until at least 2 PM CDT. For a free flyer, write to *The South Milwaukee ARC Inc., P.O. Box 102, South Milwaukee WI 53172-0102.* Talk-in will be on 146.52 simplex, and local Rptrs.

JUL 13–14

INDIANAPOLIS, IN The Indianapolis Hamfest, host to the ARRL Central Div. Convention, will be held at the Marion County Fair Grounds. Commercial Exhibits, Indoor/Outdoor Flea Market, Forums, Banquet, T-Hunts, Homebrew Contest. Write or call *Indianapolis Hamfest Assn., P.O. Box 88677, Indianapolis IN 46208. Tel. (317) 251-4407.*

JUL 14

PITTSBURGH, PA The North Hills ARC will hold its 11th annual Hamfest 8 AM–3 PM at the Northland Public Library, 300 Cumberland Rd. Talk-in and Check-ins will be on 149.69/.09, the North Hills ARC Rptr. Handicap/wheelchair accessible. Contact *John Sibenac KE3PI, 216 Kinvara Dr., Pittsburgh PA 15237. Tel. (412) 487-2740.*

SUGAR GROVE, IL The Fox River Radio League will hold their annual Hamfest at Waubonsee Community College, Rte 47 at Harter Rd. Set up Sat. 7 PM; Sun. 6 AM–8 AM. Doors open Sun. at 8 AM. VE Exams at 10 AM. Bring original license, copy of license and photo ID. Talk-in on 147.210(+) PL 103.5/107.2. Contact *Diana Skube WD9API, c/o FRRL, P.O. Box 673, Batavia IL 60510. Tel. (708) 293-7485.*

JUL 19–21

GLACIER PARK, MT The 62nd annual Glacier Waterton Internat'l Hamfest will be held at the Three Forks Campground between Essex and East Glacier MT. Contact *Bill Vodall WA7NWP, Box 75, Kevin MT 59454. E-mail: hamfest@tlatech.com. Internet: http://thor.tlatech.com/hamfest.* Talk-in on 146.520 MHz. For Campground reg., contact *Three Forks Campground, P.O. Box 124, East Glacier MT 59434. Tel. (406) 226-4479.*

PHOENIX, AZ The ARCA Fort Tuthill Hamfest will be held at Coconino County Fairgrounds in Flagstaff AZ. Times: Fri. & Sat., Dawn to Dusk; Sun., Dawn to 2 PM. VE Exams July 20; reg. 8:30 AM–10:30 AM. You *must* have original and one copy of your license and/or any applicable C.S.C.E. Photo ID required. Walk-ins only. For exam info call *(602) 440-2039.* No-Code Tech Class: contact *Morgan Riley N7DLW, (602) 938-4356.*

JUL 20

WELLINGTON, OH The Northern Ohio ARS will host "Noarsfest 96," 8 AM–3 PM at the Lorain County Fairgrounds on Rt. 18. Vendor set up at 7 AM. Flea Market. Talk-in on 146.10/.70. Walk-in VE Exams at 9 AM; reg. 8 AM–9 AM. For tables, tickets, hotel list, maps, contact *Stan Zupan AA8IN, 32549 Walker Rd., Avon Lake OH 44012-2228* (SASE required). *Tel. (216) 933-4261 before 9:30 PM; or E-mail: 75131.3561@compuserve.com.*

JUL 21

FARMINGVILLE, NY The Radio Central ARC will host "Summerfest 96" at Bald Hill Cultural Center beginning at 9 AM. Swapmeet, Tailgating. Talk-in on 145.510 (CTCSS 136.5 Hz), and 449.525 (CTCSS 114.8 Hz). Contact *Scott Johnson N2ZKB, (516) 395-2263; Emil Tilolona KD1F, (516) 696-0610,* or *John Mark KB2QQ, (516) 689-6343.*

INDIANA, PA The Indiana County ARC's 4th annual Summerfest Computer and Ham Radio Fair will be held at the Red Barn Sportsman Club near Homer City PA, 8 AM–3 PM. Contact *Bill McMillen KE3QM, RD 2, Box 157AB, Marion Center PA 15759; Tel. (412) 397-2702,* or *Tom Ringler WA3W. at (412) 349-8847. Talk-in on 146.910(-).*

VAN WERT, OH A Hamfest and Computer Show will be presented by the Van Wert ARC at Van Wert County Fairgrounds, US 127 South, 8 AM–3 PM. Talk-in on 146.850. Scanners, electronics, software, computers, used gear, hobby/craft items, more. VE Exams, pre-reg. by July 11th. Send SASE or call *Bob High KA8IAF, 12838 Tomlinson Rd.; Rockford OH 45882. Tel. (419) 795-5763, before 5 P.M.* Or call *Bob WD8LPY, (419) 238-1877 after 5 PM.*

JUL 26–27

OKLAHOMA CITY, OK The Central Oklahoma Radio Amateurs will sponsor their 23rd annual "Ham Holidays 96" at the Oklahoma State Fair Park (Hobbies, Arts & Crafts Bldg.), northeast of the I-40 and I-44 intersection. Doors open Fri., July 26th, 5 PM–8 PM; July 27th, 8 AM–5 PM. Technical and non-technical programs. Fox Hunt, Flea Market, VE Exams. Talk-in on 146.82. Address all inquiries to *Ham Holidays '96, P.O. Box 95942, Oklahoma City OK 73143; or E-mail: n1lpn@aol.com.*

JUL 27

MIDLAND, MI The Midland ARC will host their 21st annual Hamfest at the Midland Community Center, 8 AM–1 PM. Talk-in on 147.00(+), Midland. To reserve tables, send an SASE to *MARC Hamfest, P.O. Box 1049, Midland MI 48641.* For info, call Swap Manager *Bill N8LTR at (517) 832-3053 eves. and weekends.*

NEWPORT, NH Grace's Radio Shack™ will sponsor a Hamfest 8 AM–3 PM. Tailgaters Flea Market, Family Crafts Show, R.C. Model Airplane Flying Show, VE Exams, SE Station and more. Overnight camping in nearby Camp Grounds

Fri. night. Talk-in on 146.76 Rptr. For info. contact *Rob Boyd N1CIR, #648, Route 103, Newport NH 03773. Tel. (603) 863-5383. Voice contact 146.76 Rptr. Packet: N1CIR @ WA1WOK.NH*

TAMPA, FL The Univ. of South Florida Radio and Electronics Club will hold its 5th annual "Last Minute" Hamfest, 9 AM–3 PM, indoors, at the U.S.F. Tampa Campus. Enter campus on North Palm Dr. VE Exams at 11 AM. Talk-in on 146.940 (-), 442.275(+), and 147.240(+) MHz. Contact *USF Radio and Electronics Club, 4202 E Fowler Ave., CTR 2416, Tampa FL 33620. Tel. (813) 979-0033, or E-mail: douglass@suntan.eng.usf.edu.*

JUL 27–28

ORLANDO, FL The Bahia Shrine AR Unit will host "Hamcation" at Bahia Shrine Temple, 2300 Penbrook Dr., Sat. and Sun. 9 AM–4 PM. ARRL VE EXAMS: Novice thru Extra Class, July 27th. 9 AM at "Hamcation". Call Al WB4DRF, (407) 671-1056. For general info. contact *Cecil F. Morehouse K4KEN, 150 Willow Dr., Orlando FL 32807-3222. Tel. (407) 281-9169.*

AUG 3

CLAYTON, NY The Jefferson County RAC will sponsor the 1000 Islands Internat'l Hamfest, 8 AM–3 PM at the Clayton Rec. Park Arena, corner NYS RT 12 and CO RT 3. Talk-in on 146.700/.100 Rptr. Vendors must have an admission ticket. VE Exams at 9 AM (NR2S); walk-ins accepted. Contact *Janet Long N2ZMS, P.O. Box 523, Brownville, NY 13615. Tel. (315) 788-8543.*

ESCANABA, MI The Delta County ARS will host the Upper Peninsula Hamfest at the U.P. State Fairgrounds. Set up Fri. night. and 6 AM Sat. Doors open to the public at 8 AM. EST. Contact *Jim Bauer N8XAJ, (906) 786-1580; E-mail: JBAN8XAJ@AOL.COM;* or *John Anderson WD8RTH, (906) 789-9148, E-Mail:ANDEROJ@BAYDENOC.CC.MI.US.*

AUG 4

FOWLERVILLE, MI The Livingston ARK will hold the Livingston County HamFair at Fowlerville Fair Grounds, Grand River Rd. (M43); 1 mi. west of Fowlerville. VE Exams. Ham/Computer/Electronic equip., new and used. Covered trunk sales. Flea Market. Setup starts at 6 AM. Open to the public 8 AM–2 PM. SASE to *LARK, P.O. Box 283, Howell MI 48843;* or call *Ray at (517) 546-9209.* Talk-in on 146.680(-).

MARSHFIELD, WI Marshfield Area ARS will hold their 5th annual Picnic/Potluck/Swapfest in Wildwood Park starting around 11 AM. Talk-in on 147.180. All are welcome. Contact *Guy A. Boucher KF9XX, 107 West Third St., Marshfield WI 54449. Tel. (715) 384-4323. Packet: KF9XX @ W9IHW.WI.USA.NA.*

MATAMORAS, PA The Tri-State ARA will hold their 3rd annual Hamfest at Matamoras Airport Park, off Exit 11, I-84. Sellers 6 AM, Buyers 8 AM. Talk-in on 146.16/.76 PL 100, or 144.75/145.350 PL 100. Contact *Paul KD3L, (717) 491-4808; Ray WY2D, (914) 856-1733;* or *Ray AA2WC, (914) 856-0426.*

PEOTONE, IL The Hamfesters RC will hold its annual Hamfest at the Will County Fairgrounds on I-57 Exit 328 East. Open 6 AM–3 PM. Flea Market. Exhibits. Talk-In on 146.52, 146.64(-107.2), 146.94(-). Contact *John Dvorak W9ZUV, 5750 S. Newcastle Ave., Chicago IL 60638. Tel. (312) 586-0128.*

OCT 27

NEWTOWN, PA The Penn Wireless Assn. will sponsor "Tradefest '96." 8 AM–3 PM. Setup at 6 AM. The event will be held at Bucks County Community College, Swamp Rd. Talk-in on 145.25(-) PL 131.8. VE Exams. Contact *Steve (215) 752-1202.*

SPECIAL EVENT STATIONS

JUN 28–30

WATERTOWN, SD The Lake Area Radio Klub of Watertown SD, and the Huron ARC of Huron SD will operate KB0TAH at DeSmet SD from 1700 UTC–0200 UTC daily. Phone freq. will be 3.870, 7.265, 14.265, 21.340, and 28.340 MHz. CW operation will be 40 kHz up from the bottom of each band, 80–10 meters. For a certificate, send SASE to *Lake Area Radio Klub, P.O. Box 642, Watertown SD 57021-0642.* To obtain an unfolded certificate, supply a 9" x 12" envelope with two units of postage.

JUL 4–7

SAINT LOUIS, MO The Suburban Radio Club will operate WØDCW CW and phone, on the lower 25 kc of the General portion of the amateur bands, 10 AM–5 PM CDT. For a certificate, contact *Bill Coby KBØMWG, 4946 Pernod, St. Louis MO 63139-1252.*

JUL 6

DELTAVILLE, VA The Middlesex AR Group will operate Station AD4VI 1300 hrs–1900 hrs to commemorate the annual Deltaville Heritage Day. Freq.: lower General 80m–15m phone and CW, and Novice 10m phone. For a certificate, send a 9"x 12" SASE to *Peter Wright AD4VI, P.O. Box 1025, Deltaville VA 23043.*

JUL 8–9

BARABOO–MILWAUKEE, WI K9KYX/Circus Train Mobile will operate 1400 UTC–2030 UTC both days, from the Great Circus Train as it travels from Wisconsin's Circus World Museum to Milwaukee. The train will pull 20 double-length flat cars carrying more than 60 priceless, fully restored circus wagons for the Great Circus Parade which will occur the following Sunday. Operation will be on 20 or 40 meters, whichever band is in the best condition, around 7.240 or 14.240. There *may* be extended hours July 8th. For a certificate, send a 9" x 12" SASE with three units of first-class postage. SASE to *Don Evenson K9JYX, 401 11th St., Baraboo WI 53913.*

JUL 8–14

AUSTIN, TX Amateur Radio Operators affiliated with the American Assn. for Nude Recreation, the Naturist Soc., and the Federation of Canadian Naturists will observe the 21st annual N.A. Nude Awareness Celebration by operating Special Event Stations from naturist resorts, on the following freq.: 7.265, 14.265, 21.365, and 28.465 +/- QRM. For a personalized certificate, send QSL and 9" x 12" SASE to *Bob Redoutey KF5KF, P.O. Box 200812, Austin TX 78720-0812.*

JUL 13-14

SAN PEDRO, CA The United RAC and the Ft. MacArthur Military Museum Assn. will operate K6AA at the Ft. MacArthur Military Museum, 3601 South Gaffey St., 0800–2000 PDT July 13th, and 0800–1600 PDT, July 14th. Freq.: SSB—7.260, 14.280, 50.150, and 144.250 MHz. FM Voice—51.060 and 145.520 MHz. For a commemorative QSL card, send QSL and a 9" x 12" SASE to *United Radio Amateur Club, Los Angeles Maritime Museum, Berth 84–Foot of Sixth St., San Pedro CA 90731.*

JUL 17–22 & JUL 25–AUG 1

CAPE BRETON, NOVA SCOTIA, CANADA The West Island ARC of Montreal will operate from two locations on a DXpedition to Atlantic Canada. From 17–22 July a DXpedition to the Marconi Nat'l Historic Site in Cape Breton Nova Scotia will concentrate on 2-meter contacts with Europe. A CW beacon-type CQ will be transmitted on 144.020 MHz, with a reply sought on the same frequency. European hams are requested *NOT* to transmit on this frequency *UNLESS* the CQ is heard. From 25 July–1 Aug., a DXpedition to Seal Island off the southern tip of Nova Scotia will focus on a 2-meter Trans-Atlantic contact as described above, but using two separate systems, on 144.020 and 144.030 MHz. Operation will be on all bands from 160m to 70 cm (excluding 220 MHz), including the RS-10/11, RS-12/13, RS-15, AO-10 and AO-13 satellites. Special emphasis will be placed on participation in the worldwide IOTA (Islands On The Air) contest from 1200 UTX 27 July–1200 UTC 28 July. The callsign will include the suffix "CWI." For further info, contact *Fred Archibald VE2SEI at (514) 694-3441. Fax: (514) 630-4134; or E-mail: ARCHIBALD@NASH.PUBNIX.NET.CA;* or contact *Al Penney VO1NO at (902) 427-0550 Ext 3701; or (902) 876-2779.* QSL cards may be sent to *VE2CWI.*

JUL 20

CHAMBERSBURG, PA The Cumberland Valley ARC will operate W3ACH to commemorate the 132nd Anniversary of the Burning of Chambersburg PA by Confederate forces on July 30, 1864. Operation will be 1200Z–2100Z. Freq.: 3.870, 7.240, 14.250, and 147.12. For a certificate, send QSL and 9"x 12" SASE to *CVARC, P.O. Box 172, Chambersburg PA 17201.*

JUL 20-21

STRATFORD, NY The Fulton County Dr. Mahlon Loomis Committee will operate W2ZZJ to commemorate the 170th Anniversary of the birth of Dr. Mahlon Loomis, the American radio pioneer. Operation will be from 1300Z–2000Z on the General class phone portion of 75, 40, 20, and 15 meters, and on the Novice 10 meter phone band. Also on area 2-meter

FM Rptrs. For a parchment certificate and extensive literature, send QSL, contact number, and a #10 SASE (55¢) to *W2ZZJ, 5738 STHWY 29A, Stratford NY 13470.*

JUL 24–28

NANAIMO, BRITISH COLUMBIA, CANADA The Nanaimo ARS will operate CY7TUB 0001 UTC–2359 UTC, to celebrate the 30th Anniversary of the world famous Nanaimo to Vancouver Bathtub Race. Primary modes on HF (-160) will be SSB and CW. More info will be posted on the DX Packet Cluster. *Send QSL cards and an SASE to VE7NA.*

JULY 27–28

GREENVILLE, OH Station W8UMD will be sponsored by the Treaty City ARA in celebration of the Annie Oakley Parade/Festival. Operation will be July 27–28, 1300Z–2300Z, CW and phone, on General portions of the hamband. For a Certificate, QSL to *W8UMD, T.C.A.R.A., P.O. Box 91, Greenville OH 45331.*

JULY 27–29

OSHKOSH, WI Members of the Fox Cities ARC (Appleton WI) will operate W9ZL from the Experimental Aircraft Assn. Fly-In and Convention. Operation will be from "Pioneer Airport" adjacent to the EAA Aviation Museum. Listen on the General phone portions of the HF bands, as well as RTTY and CW, as conditions and operators permit. The club will also be giving "on grounds" convention info (no QSLs please) on 146.520 simplex. For an 8" x 10" picture certificate, send a proper QSL and SASE to *Wayne Pennings WD9FLJ, 913 N. Mason, Appleton WI 54914.*

LETTERS

Continued from page 62

in your head before you send. Say it aloud if you have to—sing it! Then use your hand key to make the sound you heard. If the rhythm or spacing is not quite right, try again until you are sending what you are hearing. Realize that, if not carefully sent, many characters can sound alike— "C" and "Y" for example. To make it clear, I tend to hold the final dah in the "Y" a little longer. It takes practice, like playing scales on the piano. Sit down with the latest copy of *73* and send Wayne's column on your practice oscillator. Don't try for speed, that will come. In fact, with consistent slow practice speed will creep up on you before you know it. Just keep a nice steady pace with clear characters and good spacing between. A little silence between characters and even more between words is no waste of time. It gives the other guy a chance to catch up and makes for greater accuracy with fewer repeats—nothing wastes more time than repeats.

The code was easy for me. I've a musical background—never met an instrument I couldn't play. The code is just a style of music (reminds me of the blues) and the hand key is just another instrument. This may be why I enjoy it so much. On the other hand, I know a fellow who is a fine RF engineer who could not carry a tune and cannot learn the code. He wanted to be a radio operator in the Army, but washed out and ended up being a technician.

The question I have is: Why should musical talent make me a superior radio operator? Why am I better qualified to operate the HF bands than a respected engineer with a tin ear? In the early days, when CW was the only game in town, the code requirements made sense. There is the myth that CW will get through when other methods fail. My experience has shown this to be baloney. Compared to AM, sure, but if it's hard to copy on SSB, then it's going to be tough on CW too.

I do CW for fun, but never would I want to impose my idea of fun on anyone else. Some will never learn code, others learn 13 wpm, pick up a mike and throw away the key. A few nut cases (like me) really like it.

I'd like to encourage all newcomers to give CW a try, but do it for yourself and not to be politically correct on the air. I hear many no-coders on the air say things like, "I'll start learning code as soon as the basketball season is over." This is a free country and there's no need to feel guilty about not wanting to learn code. If you learn it, learn it well and you'll find it can bring just a little bit of magic to ham radio.

Let's see, where did I put that key? ... Wayne

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

UE220 **The Easy Wire Antenna Handbook** by Dave Ingram K4TWJ. All of the needed dimensions for a full range of easy to build and erect "sky wires." $9.95

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AR4661 **ARRL's Antennas & Techniques for Low-Band DXing** can be your ticket to low-band success. $20.00

ARRL Extra Class License Manual

The sixth edition of *The ARRL Extra Class License Manual* has been completely revised and updated to match the newest Amateur Extra Class (Element 4B) question pool, released by the Volunteer-Examiner Coordinators' Question Pool Committee in December 1995. The new questions will be used on Extra Class license exams starting July 1, 1996, and are expected to be used until the year 2000.

The ARRL Extra Class License Manual includes study material for every question in the question pool, and will help you pass the written exam required for the Extra license. It also provides operating hints to help you get on the air and enjoy some of the more "exotic" operating modes, such as Earth–Moon–Earth (EME), satellites, and amateur TV. *The ARRL Extra Class License Manual* is $12.00.

1996-1997 Repeater Directory

The American Radio Relay League has released the 25th Anniversary Edition of the *ARRL Repeater Directory*, a completely updated, pocket–sized collector's edition. Besides expanded listings for U.S. and foreign repeaters, you'll find greatly expanded propagation beacon listings, information on repeater operation, interference tracking, and use of the LiTZ system, among other things. Also included are names and addresses of ARRL officers, committee members, frequency coordinators, and a complete listing of ARRL Special Service Clubs, with meeting times and locations. All this and lots more in the *1996-1997 ARRL Repeater Directory* is $8.00 and is available from Radio Bookshop. (See page 88 for order form and S&H fees.)

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

HF band conditions are likely to be in the doldrums with the usual QRN and seasonal slump in DX activity; however, the HF bands will be open long after dark, and there will be lots of vacation-time mobile and portable activity, so all is not lost.

The Earth's magnetic field—hence ionosphere—is expected to be active between July 3rd and July 7th, and again on the 31st, with possible violent storms and even earthquakes and volcanic activity during these days.

The monthly chart anticipates the 10th, 17th, and 23rd to 25th to be Good days, but the remainder of the month shows trending conditions. Possible bright spots are potential VHF opportunities during the disturbed period mentioned earlier, supplemented by meteor-burst propagation from the Delta Aquarid meteor shower which begins on the 29th and lasts about 10 days.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						20	20					
ARGENTINA	20	20	20	40			20	20	15	15	15	15
AUSTRALIA		20	20	20	40	40	20					
CANAL ZONE	15	40	40	40	40	40		15	15	15	10	10
ENGLAND			40	40			20	20	20	20	20	20
HAWAII			20		40		20					
INDIA												
JAPAN						20	20					
MEXICO	15	40	40	40	40	40		15	15	15	10	10
PHILIPPINES							20					
PUERTO RICO	15	40	40	40	40	40		15	15	15	10	10
SOUTH AFRICA			40	40		20	20				20	
U.S.S.R.							20	20		20		
WEST COAST	20	40	40	40	40	40						20

CENTRAL UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA		20	20					20	20			
ARGENTINA	15	20	20	40			20	20		15	15	15
AUSTRALIA	15	20	20	20	40	40		20			20	
CANAL ZONE	15	20	20	20	40	40	20	20	15	15	15	10
ENGLAND	20	40					20	20		20	20	20
HAWAII	15	15	20	20	20	40	20	20				
INDIA												
JAPAN		20	20					20	20			
MEXICO	15	20	20	20	40	40	20	20	15	15	15	10
PHILIPPINES		20	20				20	20				
PUERTO RICO	15	20	20	20	40	40	20	20	15	15	15	10
SOUTH AFRICA							20				20	20
U.S.S.R								20			20	

WESTERN UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA		20	20						20			
ARGENTINA	15	20	20	40	40			20	20		15	15
AUSTRALIA		20	20	20	20	40	40		20		15	15
CANAL ZONE	15	15	20	20	40	40		20	20	15	15	15
ENGLAND	20							20	20			20
HAWAII	20	15	15	20	20	20	40	40	20		20	20
INDIA				20					20			
JAPAN		20	20						20			
MEXICO	15	15	20	20	40	40		20	20	15	15	15
PHILIPPINES				20					20			
PUERTO RICO	15	15	20	20	40	40		20	20	15	15	15
SOUTH AFRICA			40						20			
U.S.S.R.									20			
EAST COAST	20	40	40	40	40	40						20

Where 10m is shown, also check 12m. Where 15m is shown, check 17m too. Where 20m is shown, be sure to look at 17 as well. Always check the bands above and below the indicated bands for possible openings to the areas shown. Remember that DX is where you find it, and not always where it is predicted to be.

JULY 1996

SUN	MON	TUE	WED	THU	FRI	SAT
	1 G-F	2 F-P	3 P	4 P-VP	5 VP	6 VP-P
7 P-F	8 F	9 F-G	10 G	11 G-F	12 F	13 F
14 F	15 F	16 F-G	17 G-F	18 F-P	19 P-F	20 F
21 F	22 F-G	23 G	24 G	25 G	26 G-F	27 F
28 F-G	29 G-F	30 F-P	31 P			

10–12 meters

This is a daylight-only band this month, but may present openings to tropical areas as well as short-skip openings on the best days (G). During intense, sporadic E conditions (rare this month) bursts of strong signals can come and go unexpectedly. Stay alert.

15–17 meters

These bands could stay open into early evening hours with possibilities of transequatorial DX on Good (G) days and evenings. Signals seem to peak toward the west during afternoon and evening hours. Short-skip to 1,000 miles or so should be available on many days.

20 meters

This should be your main choice for DX-chasing. Because some areas of the world are dark and others are in daylight at the same time, you can expect dawn-to-dusk, and even later, DX opportunities on Good (G) days/nights. Short-skip will prevail to about 2,000 miles during the day, and further at night.

30–40 meters

You may find these bands quite noisy (QRN) during the daytime, due to the onset of thunderstorms this month, but they will be quieter during the nighttime hours. DX to your east will be the best before midnight, and best to your west before dawn. Choose Good (G) days for best chances of scoring a new country. Short-skip of 100–1,000 miles during the day, and 500–2,000 miles or so at night will prevail.

80 meters

You may find that 80 meters will provide DX on Good (G) nights, limited by thunderstorm activity. It may also provide short-skip openings of 200 miles or so during the day and 2,000 miles or more after dark.

160 meters

There will be *no* daytime openings here, due to a high absorption of signals, but it ought to provide skip to 1,000 miles or so after dark. Only rarely will you find DX, and only on Good (G) nights with low or no thunderstorm activity. Low-frequency static bursts, hundreds of miles in length, limit your summer operations. 73

Number 88 on your Feedback card

MORE UPDATES

Poor Man's incorrect callsign

Sam Guccione wrote an article for us back in November of 1995 titled "Poor Man's Doppler." If you have been trying to reach him on the air, we're sorry that you haven't. His correct call sign is K3BY, **not** K3BYCC and the photographs used in his article were courtesy of N3JCP, **not** N3JGP.

Crystal–Controlled update

The November 1995 issue featured Mr. Frank Brumbaugh's article "Crystal–Controlled Audio Generator" for which we have a few corrections. Look to page 32 for these: column one, paragraph one, lines one and eight; please change "C13" to "C3". Column 3, last paragraph, lines 8 and 9, "constant frequency" should be straight line frequency, and in the same paragraph, lines 3 and 4, "constant capacity" wants to be "straight line capacity." One more thing: in the schematic, C11 should go from Q3 emitter to Q2 emitter.

440 Super-J Pole

In an effort to prevent confusion about the "440 Super J-Pole Antenna" article published in April's *73*, we offer this advice from author Marty Gammel KAØNAN: "Please connect the feedpoint as shown in the **photo**, not as the text described it. The center conductor *does* clamp to the short vertical element." 73

Including Ham Radio Fun!

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AUGUST 1996
ISSUE #431
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See Page 4

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Manuscripts: Contributions for possible publication are most welcome. We'll do the best we can to return anything you request, but we assume no responsibility for loss or damage. Payment for submitted articles will be made upon publication. Please submit both a disk and a hard copy of your article (IBM or Mac formats), carefully checked drawings and schematics, and the clearest, best focused and lighted photos you can manage. "How to write for 73" guidelines are available on request. US citizens must include their Social Security number with submitted manuscripts so we can submit it to you know who.

73® Amateur Radio Today

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ISSUE #431

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HAM RADIO FUN SECTION

On the cover: Ten-Tec provided the cover shot this month of their Model 1220 2 meter FM tranceiver kit. Included in the photo is their 1222 power amplifier kit which is available as an accessory.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Contract: Even the most cursory glance at this text is sufficient to bind you, morally and legally, to take a kid (or kids) along on Field Day, get 'em fired up on amateur radio, and then help 'em gel started toward a license. You'll feel good about yourself and our legal deoartment won't have to hassle you.

NEVER SAY DIE

Wayne Green W2NSD/1

As a salve for those readers who are monomaniacal about the hobby and don't want to read or know about anything else, my editorial this month is strictly ham oriented. This is frustrating because there have been some amazing non-ham or semi-ham things taking place that I think many of you would enjoy reading about. Like a fantastic $5 book I've found that explains an ultra-simple way anyone can find out what they're allergic to, and thus help them get rid of arthritis, multiple sclerosis, and a bunch of other weak immune system miseries (like cancer).

Then there was my four-hour guest shot on the Art Bell W6OBB talk radio show. The thousands of letters and orders for my booklets resulting has dominated my life for the last month. My talking about amateur radio has resulted in hundreds of new subscribers. It's had my copy and folding machines running overtime, with me data entering the booklet and subscription orders, then assembling and mailing my booklets. Whew!

In order to keep this month's column hammy I've robbed some of the stuff from my 84 pages of editorials not yet published in *73* booklet, making it now editorials mostly not yet published in *73*.

News Flash: Money Talks

Many nervous Techs have been asking me what I think of the move by commercial interests to buy our 144 and 450 MHz bands. My answer is simple: Money talks when you're dealing with politicians. Even the FCC (as well as Congress) was amazed at how much the spectrum turned out to be worth when they put it up for auction. Mmm, billions! More money to spend! More pork! Let's see now, what social programs can we cook up to take care of this bonanza? If you're not up on how Congress works, there are a couple excellent books on my $5 recommended reading list that will enlighten and disgust you. Hey, they might even be enough to get you to start thinking. Well, maybe not. We seem to have a lot of hard corpse cases out there in hamland.

However, there's one other commodity politicians understand, and remember that the FCC Commissioners are all political appointees. Politicians understand votes.

That's why, when I got fed up with the idiotic repeater restrictions Prose Walker engineered, I organized a hearing before the Commissioners to get our repeater rules changed. I not only brought in a parade of carefully rehearsed repeater group representatives to testify, I also waved a thick stack of petitions at the Commissioners. The repeater groups had collected thousands of signatures at hamfests and club meetings, and it was these, more than reason, that carried the day. Reason is not a powerful weapon when dealing with politicians. Anyway, the result was that we brought about the largest bunch of rule changes in the history of the FCC. We even helped trigger not just the deregulation of amateur radio, but also the other services.

Anticipating just such an attack as we are now facing from the moneyed big boys, I've recently proposed in my editorials that every ham club make it project number one to get a club member elected to their state legislature. We need the clout ham legislators can provide in every state, and not just to help us fight off commercial raids on our bands, but also to kill tower restrictions and to help implement my own pet project: an eight-year course in electronics, communications and computers in every school in the country, grades 5-12. Ham legislators also will have the ear and eye of the media, which will also help give us some desperately needed political clout.

Two meters is the most used of all out ham bands, by a wide margin. What will the loss of two meters (and 450) mean to us? Well, that would pretty much put over half our hams out of business. The Tech half, which has been brainwashed into believing that learning the code is totally beyond their ability, will have few practical options. Thus, in eight to ten years, when their licenses aren't renewed, the FCC figures will drop precipitously.

Oh, a few will manage to overcome their mental block about the code and join us on the low bands. Fewer still will move to 50 or 222 MHz.

With all those satellites up there providing dependable communications, there's no longer much commercial interest in our HF bands, so we'll probably hold them until the few of us that are left die off. Frankly, I expected to see our virtually unused microwave bands be the first to go. These are prime targets for the proposed new satellite consumer services.

Meanwhile, I'll be checking the ham club newsletters for signs of activity in backing club members in a run for state legislatures, at least with as much enthusiasm as supporting Walk-A-Thons. We sure don't have any money, so all we've got are votes to work with. And that means playing the politics game. Or else.

Atlanta Hamfest!

Well, it seemed more like a computerfest, looking at the exhibits. And more like a geriatric convention, looking at the attendees, what few there were of them. This is terrible!

Atlanta is the hub of the whole southeastern US, yet I doubt if a thousand hams bothered to turn out for the hamfest. I went around the place counting heads several times during the day. I came up with between 600 and 700 on most sweeps, and that included the out-of-the-way commercial exhibit area, the three talk rooms and the flea market. I saw almost no youngsters all day.

I checked the talks every hour to see what kind of crowds they were pulling. Packet: zero! Repeaters: one. DXCC pulled a big four. The ARRL meeting pulled a whopping nine. Antennas had five. Beginners had four. The two DXpedition talks pulled 17, the biggest crowd of the hamfest — except for my talk, which was scheduled at the close of the show, when everyone was hot and tired, and pulled 48. There was no mike, so I had to do the best I could over the noise of the big fans (air conditioning in sizzling Atlanta? Har-de-har). The hamfest was held in a dirty old Sears warehouse.

Now here's a show that should have pulled in hams from all over the south. They should have had at least 15-20,000 hams there. They should have had the whole ham industry exhibiting. They should have had top-notch entertaining speakers to help pull in the crowds. So what has happened? Is ham radio dying in the South, or is this the sad result of local clubs refusing to cooperate for the good of the hobby?

We're at a time when we need all of the cooperation we can get between clubs. With the threatened loss of our no-code bands, and with well over half our hams being Novices or Techs, the last thing we need is foot-shooting rivalries.

The club couldn't afford to bring me down to talk, so I paid my own (and Sherry's) way, hotel, rental car, and meals. What I found was a well-lit flea market area packed with software sellers (mostly games), and the commercial exhibitors way off in a dimly-lit back area, where

Continued on page 31

LETTERS

From the Ham Shack

David Plett 3A2LZ. Greetings from a US ham in Monaco. I am strongly opposed to the idea of upgrading senior citizens, as an article proposed. Here's why. The basic purpose of amateur radio is to develop a pool of people trained and skilled in electronics and communications. Reducing the technical knowledge and requirements is contrary to this goal. Math requirements certainly should not be reduced. In fact, they probably should be increased. You are not required to do everything longhand to the 19th decimal place. "Filling in the blanks" and basic calculator functions suffice. The correct answers are easy enough to memorize. I memorized the Advanced and Extra theory questions in three days while driving around central Florida during a short stay in the US in 1993. The math included is part and parcel of basic technical requirements for any higher-class amateur radio license in any country I know. I am against favoritism. This is not in a spirit of cruelty, or to say that experience does not count or that we should not try to help those who have difficulty with the theory. However, the fact that somebody is a good "on-air" ham or a nice guy should not be an excuse for allowing technically unqualified people to be given higher licenses. The better response is to help those with difficulties. Those of us who have an easier time with theory, code, or regulations (my most difficult area) have an obligation to help others. It has been suggested that the US technical requirements are higher than those generally used in Europe. This is not so. Most US hams I speak to find the Advanced test to be the most difficult technically. The Extra exam covers mostly VE matters. From my exposure to European hams, the technical exam for the entry-level license (VHF only), where there is no Novice license, covers approximately the same material as the Novice through Advanced US tests. However, it is not always "multiple-guess" and often requires one to illustrate and analyze circuits without having seen them previously in the same form. The CW test usually requires both sending and receiving. The receiving test is even more difficult since it is usually not multiple-choice. The transmit test sometimes requires up to five minutes of text be sent error-free. We need to keep high technical standards for amateur radio licenses; not to keep people out, but to fulfill the obligation to train people for the real world of electronics today.

The Smithsonian Answers

Bernard S. Finn, Curator, Electrical Collections, Smithsonian. In recent articles in the magazine *73 Amateur Radio Today,* John Wagner has made several statements about the historical role of Nikola Tesla, about the Smithsonian's treatment of Tesla, and about Mr. Wagner's communications with the Smithsonian. Not surprisingly, my views are somewhat different from his, as reflected in the following comments.

I. The historical role of Tesla

There is little question that Tesla was a genius, whose fertile mind generated a number of ideas at the cutting edge of the electrical technology of his day. Indeed, plausible arguments are made that some of his concepts can be useful in investigating phenomena that we still don't understand. However, like many geniuses, Tesla was a loner. He had difficulty working with other engineers—whether in explaining his ideas to them or in considering their criticisms. The unfortunate consequence of this was that his impact on practical technical developments was severely impaired. This does not make him less interesting; indeed, for those of us who are concerned with the roots of creativity, it makes him, if anything, more so. But it does mean that we should be careful in what we claim were the consequences of his activities.

Tesla's concept of the rotating field was clearly innovative and was recognized as such by George Westinghouse when he negotiated to purchase the patents in 1888/9. But to claim, in Mr. Wagner's words, that "he created the polyphase alternating current system of motors and generators that powers our world" ignores contemporary European systems that relied on the work of Pacinotti, Brown, Dobrowolsky, Wenstrom, and also Westinghouse engineers who, with Tesla's help, translated those patents into practical electrical technology.

It also ignores the complexity of the history of electric power systems. A starting point might arguably be the development of the self-excited dynamo in the 1860s (Siemens, Wheatstone) which was efficient enough to make lighting and power systems (both AC and DC) practical, especially with better magnetic design in the 1870s (Gramme and others). That made it feasible for arc lighting, incandescent lighting, street railways, and other applications to become widely available. The AC transformer in the mid-1880s (Gaulard, Gibbs, Blathy, Zipernowski) made possible long-distance transmission (though this could also be done, with less efficiency, for both AC and DC using motor-generator sets). Multiphase AC operation, with which Tesla is associated, made transmission more efficient; it also gave us an AC motor. More recently, development of means for transforming DC has meant even more efficient means of long-distance transmission at very high voltages.

Incidentally, Edison's role in this particular sequence is modest, being confined primarily to the design of a more efficient DC generator.

Tesla is given credit by Mr. Wagner for "every essential of radio." This statement is presumably based on his patents for basic tuning concepts. Eventually the US Supreme Court held that these, together with patents of John Stone and Oliver Lodge, anticipated those of Marconi. But Tesla was ineffective in promoting any system of his own, and although it is intriguing to think that his work may have had a significant impact on others, good historical evidence of that is lacking. Starting from the experiments of Hertz, it was Marconi, Stone, De Forest, Fessenden, and Braun, among others, who developed practical radio technology. They were aware of some of the details of what Tesla was doing, but, as far as we are able to discern, they came to their own basic ideas independent of him. We can therefore marvel at Tesla's early understanding and articulation of some important concepts, but should beware of extending him credit for everything that followed.

II. The Smithsonian's treatment of Tesla

Although the Smithsonian is a large enterprise, so also is the scope of our mandate. Our museums cover a vast range of history, culture, and technology. Our resources—in space, money, collections, and personnel—are limited. Because we cannot address everything in our exhibits, we generally take one of two approaches. We may do a broad survey—as presently is the case with the "Information Age"—where individual subjects and people are given relatively brief mention. Thus, in that exhibit, in a section on wireless and radio, Tesla shares space with Hertz, Lodge, Marconi, De Forest, Armstrong, and others. The other approach is to do a smaller exhibit with a focus on a particular topic or person. Thus, in "Lighting a Revolution," we pay special attention to the incandescent lamp and to Edison. Other people are included, most notably those who were directly involved in that development—like Brush, Farmer, Thomson and Swan. We pay less attention to subjects like the competing gas light technology or the development of later distribution systems.

In "Lighting a Revolution," we try to describe the origins of Edison's work and as well as its impact. Our concern is with the light bulb. We do not claim, as Mr. Wagner suggests, that Edison "invented DC electricity" or that he "invented AC electricity and harnessed Niagara Falls." We argue that, because of the popularity of the incandescent lighting, there was an incentive to develop large-scale generating systems (at the same time granting that there were other factors, including street railways and electrochemical processes). We allow this argument to lead us to say that the light bulb was a key element encouraging the creation of the Niagara Falls station, not that "he made the Niagara project possible." There is no claim that Edison had anything directly to do with that station. Indeed, because we use Niagara Falls simply as

an indication of America's commitment to a new electrical age, we, rightly or wrongly, don't describe it in any detail.

We do, however, include a Tesla motor and a nameplate from a Niagara Falls dynamo (we have the dynamo itself in our collection, but at 85 tons it would not easily fit in the exhibit). There is a picture of Tesla and a short biographical sketch (which admittedly are not prominently displayed).

Mr. Wagner notes that this exhibit was sponsored in part by the Thomas Alva Edison Foundation (actually through an International Committee for the Centennial of the Electric Light). We are very sensitive to the problems potentially associated with sponsorship, no matter where it comes from. Unfortunately, exhibits cost money, and it is necessary in most cases for us to seek outside help—which usually comes from people who are interested in the subject we want to treat. Realizing this, we *insist* that the money comes without strings, that we are the ones who determine what objects and what text are included. In this particular case I know that the committee exercised no influence over the content of the exhibit.

In the catalog of the exhibit, mentioned by Mr. Wagner, we included the biographical sketch of Tesla described above. A revised edition specifically credits his patents as the basis for the Niagara generators.

Several years ago we organized a one-case exhibit for a special event at the National Academy of Sciences. Afterwards we displayed it for several months near the Niagara Falls nameplate mentioned above. It was well lit and was definitely not "in a darkened hallway next to the men's room," as stated in Mr. Wagner's article.

We have long been of Mr. Wagner's view that a more extended study of Tesla would be appropriate for an exhibit. Unfortunately, we have virtually no artifacts for such an effort beyond those already in "Lighting a Revolution." We obtained a small grant to explore the possibilities of a joint endeavor with the Tesla Museum in Belgrade, where virtually all the surviving Tesla material is preserved. They were excited about the possibilities and some tentative agreements were made. We hoped to have something together by 1993, the centennial of the Tesla displays at the Columbian Exhibition in Chicago. Tragic political events with which all of us are familiar intervened, and the project was put on hold. Recent developments hold promise that we may be able to begin again, assuming that further funding can be found.

I should add, however, that when we do such an exhibit it will not be a simple celebratory event of the sort Mr. Wagner seems to envision, any more than "Lighting a Revolution" or the "Information Age" are. This is a history *museum*; in it we try to promote a better understanding of people and events by presenting them in the context of their times. The complexity and richness of personalities like Tesla and Edison deserve no less.

Meanwhile, when we make some modifications in the "Lighting" exhibit next year to include more recent developments in lamp technology, we plan to expand our treatment of AC systems, which will allow us to say more about Tesla's contributions.

III. John Wagner and the Smithsonian

For several years Mr. Wagner has been attempting to have Tesla better represented in this museum. He is not alone in this desire (nor is Tesla the only person with advocates) and we appreciate his efforts. In the process, he has no doubt encouraged a number of people to learn about this remarkable man, and he has encouraged us in our own researches.

I have been especially impressed by the fact that he has gotten his third-grade students to learn about Tesla. They have been articulate in their letters to the Smithsonian and they have apparently been sufficiently persuasive to corporation presidents to elicit $50 and $100 contributions to pay for the casting of a bust of Tesla which had been sculpted by the father of one of the students. Certainly this is a good thing for them to do—as long as they realize that we may have good reasons for not automatically acceding to their demands that this bust then be exhibited at the Smithsonian.

As Mr. Wagner notes, the bust was offered to one or two other museums and then to us. The Smithsonian has a policy of not accepting busts unless they are made from life and we declined the offer. Furthermore, there was no particular reason to accept it, since we have no gallery of inventors or other context for it.

We do have a bust of Edison, as Mr. Wagner mentions. It was made from life, by a phrenologist who wanted to examine the bumps and hollows on Edison's head—making it doubly interesting. It is exhibited (not near Tesla's motor) as part of an attempt to demonstrate how Edison had excited public admiration even before he started work on the electric light; this was an important factor when he looked for funding for his investigations.

In sum, there is no vendetta or conspiracy within the Smithsonian against Nikola Tesla. We currently have an exhibit featuring Edison's electric light—because we have excellent material and an interesting story to tell. Circumstances in the future may lead us to treat other Americans of that pioneering generation, like Charles Proteus Steinmetz, or Elihu Thomson, or William Stanley. We had specific plans to do so for Nikola Tesla. At the moment these have been thwarted, but we hope we will be able to resume the endeavor before long.

John Uscinowski KE2O (ex-W2JMR). I have been licensed since 1935. I built my own test equipment, transmitter, and receiver. I remember going to Cortlandt Street to Harrison Radio, Leeds, and Blan The Radio Man to buy parts. Since I lived in Yonkers, it was a nickel on the trolley and a nickel on the Van Cortlandt subway. Please keep plugging away, steering us back toward basics.

It was also a nickel via the BMT subway from Brooklyn, so I spent a lot of time shopping the radio stores of Cortlandt Street back in the 1930s. And Radio, Wire, Television, later named Lafayette Radio, 100 Sixth Avenue, was a wonderful source of parts. Then there was the WWI surplus stuff on Fulton Street ... Wayne.

Alexander Dumble. Your recent guest appearance on the Art Bell Show was the best show of the entire series to date. Your stands on technology and the philosophical applications give a posture of hope and accomplishment; and I am one who dearly appreciates what you've brought to the arena. The cold fusion phenomena has captured my attention, and I want to build a working model. In my circle of friends we have built and operated wind-powered electrical generators, and these devices are encouraging. However, the thermal potential of cold fusion cells really sounds wonderful. So getting information to start experiments is now paramount.

Your presentation concerning Bob Beck was delightful to hear. Bob has been a mentor to me and many others for the past decade, going back to the old Psychotronics Club, here in the LA area. The club is no longer going, but the legacy that Bob has imparted is very much alive and well. Personally, I have assembled many Beck devices, and so far have built thirty of the "plant stimulators." I was an original subscriber to *Byte*. Despite all the floods and earthquakes, these original issues of *Byte* are still here with me and treasured. Thank you, sir, for what you have brought to the world.

Wow! And just when I thought I was beating Rodney Dangerfield in the "don't get no respect" race. Well, maybe this counters a nasty note I got from some sniveling lily-livered yellow-bellied Philadelphia coward who didn't have the guts to sign his name ... Wayne.

John Schultz W4FA. Shame on you for printing that article on antennas using copper foil tape without checking things out. The 3M tapes mentioned are extremely difficult to find and the *only* distributor for them in NC has a $75 minimum order.

Anyone else have trouble finding the foil tape? If so, make an omelet by buying $75 worth and running an ad to sell the stuff to hams retail. Look on any problem as a golden (well, copper) opportunity ... Wayne.

QRX . . .

FCC Criticizes Consumer Equipment

The FCC recently released a statement saying that most Radio Frequency Interference (RFI) problems are caused by faulty design of consumer electronics equipment such as VCRs, telephones, and TVs. The statement is good news for hams who now have the FCC on record as agreeing with what many hams have maintained for years. Such statements will be of great value in fighting RFI complaints and defending hams against capricious lawsuits which some angry consumer gear owners have initiated.

Meanwhile, the FCC has given up on its pilot project, which tasked consumer electronics service shops with evaluating RFI complaints. The Tampa FCC began the project in 1994 but only one shop was ever certified and its spokesman concluded that most problems were caused by unlicensed transmitters using illegal power. Also, it was never settled as to who would pay for the shop's services. Most consumers were unwilling to pay to have their RFI evaluated. Reportedly, the FCC is no longer handling any RFI complaints and is advising consumers who complain to direct their comments to the Electronics Industries Association, a group that represents equipment manufacturers.

TNX Billy Williams N4UF, *Balanced Modulator*, North Florida Amateur Radio Society's newsletter.

Pretty Sneaky

The April OH-KY-IN ARS foxhunt was one of deception—the fox, Dick WB4SUV, had taped a quarter-wave dipole to the bottom side of a fishing pole. The coax ran through the center of a bamboo prop for the pole. The batteries and transmitter running 50 watts were located inside an adjacent tackle box with a see-through cover, filled with fishing lures. The equipment was set up under the new Central Bridge on the Kentucky side of the river, and included two volunteer fishermen. The high power on the water's edge created many reflections on both sides of the river, along with a reported 100 dB attenuation needed two miles away in Devou Park. The sniffing part of the hunt was interesting, as both teams avoided disturbing the fishermen!

TNX Dick WB4SUV, *The Q-Fiver*, official newsletter of the OH-KY-IN Amateur Radio Society.

Amateur Radio Called an "Invaluable" Resource

A powerful late winter storm triggered severe thunderstorms, tornadoes and up to golf-ball-size hail over central and south Alabama. The National Weather Service said it issued 48 tornado and severe thunderstorm warnings during the afternoon and evening of March 18, 1996, "So many warnings that we overwhelmed the media in some situations," said Brian Peters WD4EPR, a Weather Service meteorologist in Alabaster.

At the Weather Service Forecast Office in Alabaster, Skywarn teams went on duty in mid-afternoon, opening nets on 2 meters, 440 MHz and 220 MHz, and remained there for nearly six hours. Amateurs manning the Net Control posts described the outbreak as one of the most intense in recent history, with severe weather occurring in several parts of their coverage area simultaneously. As powerful thunderstorms approached central Alabama from the west during the afternoon, radio amateurs began reporting damaging winds, hail, heavy lightning, and torrential rains on W4CUE, the Birmingham Amateur Radio Club's 146.880 MHz repeater. Amateurs operating a separate Skywarn Net in Hueytown in west Jefferson County assisted by turning in reports they were receiving. Weather Service forecasters listened closely to storm spotters and compared their information to the data being fed by Doppler radar.

While severe thunderstorms were pounding Jefferson and Shelby Counties, heavy thunderstorms began developing almost explosively in a line stretching from Birmingham south to near Montgomery; at one point, at least six counties were under warnings at the same time.

Radio amateurs activated Skywarn Nets in Montgomery, after getting advance warning from hams at the Alabaster Forecast Office who were using a recently installed 220 MHz link, connected to the N4PHP 220 MHz repeater in Shelby County. Numerous severe thunderstorm and tornado warnings were read over the link, sometimes giving Montgomery Skywarn teams their first notice that a warning was being issued for their area.

Peters said radio amateurs did a fabulous job. "I was amazed at the reports coming from hams all over the state and how well the hams were working together. It used to be that hams gave us reports from just the local area, but they were giving us information from Tuscaloosa, Fayette, Monroe County, and Montgomery.

"Amateur radio proved its worth again as an invaluable source for confirmation of weather events." Peters praised the speed with which amateurs relayed severe weather reports to the Weather Service. "We were getting reports from a bunch of different places and, nine times out of ten, the first reports were coming from hams."

Amateurs in the Montgomery area provided real-time observations of a funnel cloud north of the city and later reported a tornado on the ground. The tornado first touched down in Elmore County and then moved into Tallapoosa County, remaining on the ground for 30 miles, Peters said. In Tallapoosa County, the tornado hit a marina on Lake Martin and caused heavy damage to mobile home parks.

The ARRL's Alabama Section Manager, Tom Moore KL7Q, of Salem, was actively involved in storm spotting in east Alabama. "We were closely following the Montgomery activity that tracked across Elmore and Tallapoosa Counties. We had a live sighting of the tornado for several minutes before it hit the marina and Jackson's Gap, and several other severe thunderstorms down as far as Lee and Chambers County," Moore said.

Injuries were reported in Lowndes County, southwest of Montgomery, and more than 60 families were left homeless by the storms.

Peters said being within earshot of amateur radio proved handy to meteorologists analyzing Doppler radar displays of the storms. "I noticed that the staff every once in a while would hear words like 'golf ball.' Everybody at the radar console would get quiet and listen to what was coming in over the amateur radios."

A Skywarn team member who monitored emergency frequencies during the outbreak praised the efforts of his fellow hams. "This was the best Skywarn operation I've heard yet, on the part of the volunteers running the nets and on the part of the general ham community in providing timely, useful information," said Jim Smiley KE4CAP, of Alabaster.

Amateurs serving as Net Controls in Alabaster included Rick Kimbrell KC4RNF (ARRL Alabama Section's Emergency Coordinator), John Simons KC4UCP, Mark Parmley WA4UHC, and David Black KB4KCH.

Skywarn Nets were also active throughout east and west Alabama, including Tuscaloosa, Calhoun, St. Clair, Blount, Chilton, Tallapoosa, and Talladega Counties. In east Alabama, the Salem Hill Skywarn Net had an estimated 44 check-ins. Amateurs also staffed the Birmingham-Jefferson County EMA headquarters, assisting with damage reports.

Amateurs running Net Control Posts praised the quality of reports received from spotters in the field. On Birmingham's 146.880 MHz repeater, numerous hail reports were received from hams who gave specific size and location information along with wind speed estimates and other pertinent data.

Rick Kimbrell called the episode a test of nerves, hearing, coordination, organizing skills, and writing speed. "I thought the nets ran very well," Kimbrell said. "I was really pleased to see and experience working with the Montgomery group and the link that has been established. I thought it worked great."

The March 18th emergency marked at least the third time radio amateurs have set up Skywarn Nets for the Weather Service in 1996. Ironically, the March 18th storms forced a change in plans for Peters, who had been scheduled to lead a Skywarn training class for amateurs in Montgomery that evening. When the storms broke out, Peters canceled his appearance and remained at the Alabaster Forecast Office instead, manning one of the Doppler display consoles and analyzing wind patterns. Kimbrell, who had planned to accompany Peters to the Montgomery meeting, assisted with Skywarn Net Control duties instead, remaining on the air for nearly five hours.

From an article by David Black KB4KCH, ARRL Alabama Section Public Information Officer, in the April 1996 issue of *The BirmingHAM*, Official Publication of the Birmingham Amateur Radio Club.

It's a Fashion Statement

The "typical" ham:

- Wears button-up shirts, usually done up to the collar button but *never* undone below the second button.
- Wears an undershirt, even on hot, humid days.
- Wears polyester pants (usually too short).
- Wears pants revealing argyle socks and well-worn, outdated shoes.

• Has at least two writing implements in breast pocket of shirt.

• Has a digital watch, normally with two time zones (one of which is set to GMT), synchronized to the second with WWV or CHU.

• Is at either extreme of the body-weight spectrum.

• Wears glasses—even those who should only wear glasses for reading will actually wear them all the time.

• Has a wallet hopelessly overstuffed with pieces of paper of little or no importance.

• Has hair that's short and/or gray and/or thinning, devoid of style and probably not as clean as it should be.

• Has a handie with the "extra capacity" NiCd battery pack and the "Mega-gainer" antenna which serves to poke you in the face (or other, equally sensitive, body areas) when it is swung around.

• Uses Q-codes even in casual conversation.

• Wears a plastic name badge with the callsign bigger than the name.

Your Car's a Statement Too

The "typical" ham's car:

• Is typically, but not always, purchased used, with careful attention paid to large, flat horizontal areas of metal.

• Must have automatic transmission so that something as trivial as operating the vehicle does not interfere with a "QSO."

• Has lots of leg room so the driver can operate iambic paddles strapped to his calves.

• Has the ashtray removed to allow more room for radio equipment.

• Has loose wires visible either under the dashboard or in unusual place(s).

• Back seat contains the following: old copies of ham magazines; current copies of ham magazines; spare wire mag-mount; butane-powered soldering iron; solder; empty cigarette packs; parts of various antennas; SWR bridge; literature about new radios; more copies of old ham magazines.

• Will sport at least one of these bumper stickers:

ICOM–discover the quality
KENWOOD Amateur Radio
Yaesu Communications Equipment
Amateur Radio Spoken Here
Dayton HamVention 19__
Amateurs Do It 'Til Their Giga-hertz!
Hams Do It With Greater Frequency!
This Car Climbed Mount Washington

• Mechanics can easily identify a "ham" car by looking under the hood. Large wires lead mysteriously from the battery, which is usually about 875CCA, into the cockpit of the car. Careful attention has been paid to installing resistor-spark plugs and RFI suppression wires and ignition components. Special ingenious modifications have been made to the battery box to allow the installation of this *huge* battery—often involving bungee cords and bent pieces of sheet metal. The alternator is either new or has been recently replaced with a 100A unit.

• Bristles with antennas of differing lengths—some of these antennas look like big marshmallows on nine-foot sticks ... and at least one of them isn't even connected to a radio!

• License plate is callsign, of course.

Lifted from *NOARS LOG*, Official Publication of the Northern Ohio Amateur Radio Society.

Add These to Your "Computerspeak" Glossary:

ATTENUATE: Response to a cannibal who's eaten the very best and asks you to rate it for him.

AUTOMATIC CHECK: The one you write every month to your software supplier.

AUTO-ANSWER: Similar to "Dial-a-Prayer," but instead of a clergyman you get Mr. Goodwrench.

AUTO-REPEAT: A key which, when held down, when held down, when held down ...

AUXILIARY MEMORY: What you go to when she doesn't believe you were working late at the office, e.g. "The train was hijacked to Cuba."

BACKWARD RECOVERY: Clintonomics.

BADGE READER: Convention-goer who gets off on reading "Hi, I'm ... " badges.

BAGBITING: What happens when you don't unwrap your sandwich.

BANKS: Quiet, air-conditioned places where your salary is automatically transferred to peripheral salesmen.

BAR CODE SCANNER: A bouncer who checks the crowd for jackets and ties.

BARREL PRINTER: The guy who writes XXX on whiskey kegs.

BASIC: Something so "simple" you need a computer to understand it.

BATCH: A minor gripe.

BATCH PROCESSING: Cleaning up a batch so you can say it in mixed company.

BAUD RATE: Fee charged by loose women; usually $5.00 and up. *(Ed. note—how does he know that?)*

BELL LABS: Large black retriever dogs that go "Ding-a-ling!" instead of "Bow wow!"

BENCHMARK: Painful creases pressed into chips from sitting for long periods on park benches.

BI-DIRECTIONAL: A computerist who swings both ways.

BINARY: A little yellow bird that waves instead of whistles.

BINARY FILE: A whole row of them.

TNX to Vince WA8BIJ and *Tuned Circuit*, L'Anse Creuse Amateur Radio Club.

Please turn to page 86 for
Tri-Ex Corporation's ad.

Build the QUAD-12 Personal Datalogger

Mike Gray N8KDD
1680 Cooley Lake Road
Milford MI 48381

There are several peripherals capable of converting a personal computer to a data acquisition system, but none that I know of are well suited for a laptop computer, and all of them are expensive. This quick project will be easy to assemble and to use. It's based on the new MAX186 Analog-to-Digital (A-D) converter from Maxim. You'll need only a few support components to complete the package. It's small, rugged, reliable, flexible, and cheap. Perhaps best of all, it doesn't need a battery, as the PC printer port supplies what little power it needs. The entire circuit fits in a DB-25 connector shell, including a terminal strip for connections to your various inputs.

What can you do with an A-D converter? An A-D converter lets you get information from the "outside world" into your computer. It seems that everyone has his own unique need for data acquisition. A-D converters are used in astronomy, seismology, plant growth research, and a host of other applications. An A-D converter can monitor battery voltages, RF power levels, fluid levels and pressures—practically everything can be monitored with the proper sensor. Most folks want to record temperature; this is easily accomplished with an LMØ4 temperature sensor.

Circuit operation

The easiest way to understand the operation in this configuration is to follow the BASIC program listed in the sidebar while referring to the schematic (**Fig. 1**). In order to understand the circuit operation fully, you need a timing chart. You can get a data book from Maxim and trace the logic for each pin, then change the mode of operation once you know how it works.

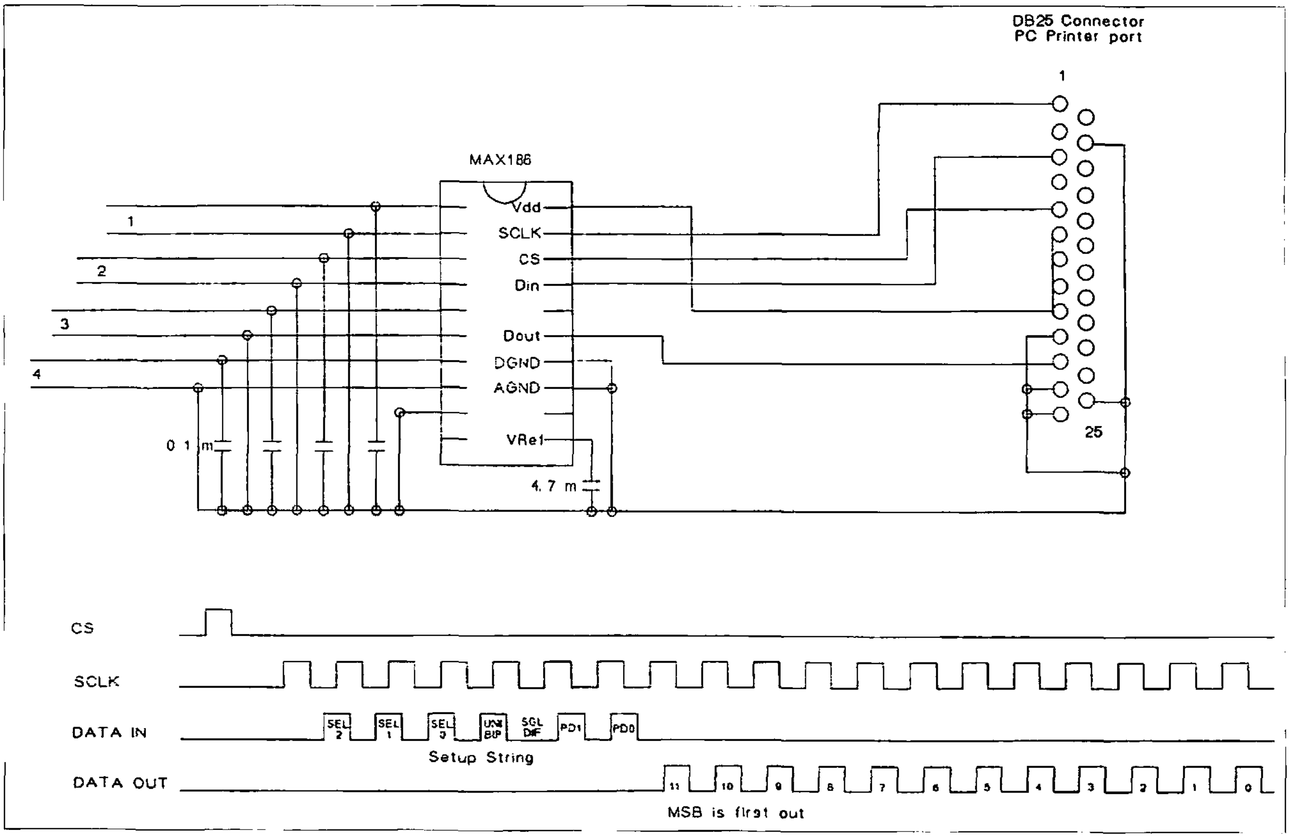

Fig. 1. Schematic diagram and initialization timing diagram for the Datalogger.

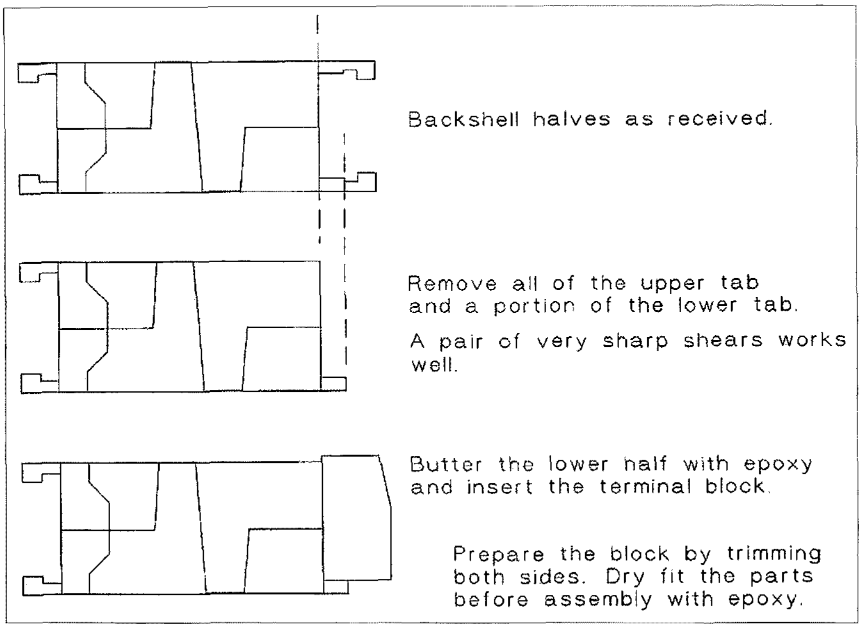

Fig. 2. Modifying the DB-25 backshell to allow mounting of the terminal strip.

Although the chip has eight analog input channels, this project uses only four so it'll fit neatly within a DB-25 backshell. The channels are configured as pseudo-differential with the low pins tied to a common ground. Most measurement systems share a ground anyway, so this arrangement will work well unless there is a difference in ground potential somewhere between the computer and the transducers. I've seen this happen only in automotive applications where the computer is being charged through the lighter socket. Lighter sockets are typically grounded to the body metal, which has a ground potential about 300 mV above engine ground. If the transducers are grounded at the engine block, you have a 300 mV error. The error changes as a function of charging current. If you run the computer on its internal battery you will have no problems with ground loops.

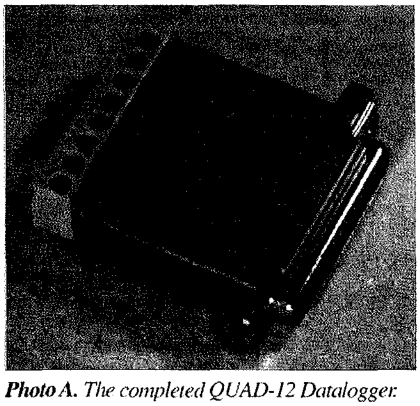

***Photo A.** The completed QUAD-12 Datalogger.*

The 0.1 µF surface mount capacitors (C1-C4) on each input channel form crude anti-aliasing filters. They help prevent high-frequency noise from influencing the data when sampled at a relatively low rate. The MAX186 has a high input impedance. Without the capacitors, an open channel can appear very active due to static charges or electric fields.

Software

The BASIC listing in the sidebar on page 15 shows the minimum code required to make the QUAD-12 work. You can insert it in your own application or use it just the way it is. The program simply causes the MAX186 to scan the four analog channels and print the conversion result to the screen. The source code is specific to PowerBASIC™. You may need to change the syntax or function names slightly to make it work with another version of BASIC.

After devising several application-specific programs, I wrote a generic data acquisition program for my needs. It has many of the features included in the high priced engineering software, like color graphics and mx+B scaling. It requires a 386 processor and VGA graphics. The Datalogger software is available with the complete kit of parts, or with the bare board. Check the listing at the end of this article.

Construction

The terminal block is glued into the backshell. Most epoxies take several hours to cure, so it makes sense to start by assembling the shell first, allowing the epoxy to cure while you assemble the other components.

Using a sturdy pair of sharp scissors, cut the backshell tabs according to **Fig. 2.** Cut the small studs from the bottom of the backshell with a sharp knife or flush cutters. I've found that the flush cutters work best. Trim the sides of the terminal block until it fits snugly into the backshell. When you are happy with the fit, apply some epoxy to both parts and clamp them in place until the glue is cured. Trim the circuit board with a file or grinder. The board supplied with the kit is a little larger than it needs to be, due to an artifact of the manufacturing process. The board fits snugly between the pins of the DB-25 connector.

Solder all five surface mount capacitors to the board. If you have never installed a surface mount component, don't be intimidated—it's really quite easy. Pre-tin one pad with enough solder to form a bead slightly larger than the end of the component. Position the component, apply a little pressure, and reflow the solder until it wicks up the side. Solder the other pad, then check your work. If the solder joint doesn't shine, add a little solder. Once you get a feel for how much solder to pre-tin the board with, you won't need to resolder any joints. All it takes is a little practice.

Bend the pins on the A-D converter (IC-1) outward until they are horizontal. Trim the pins so they fit within the confines of the board. Referring to **Figs. 3**

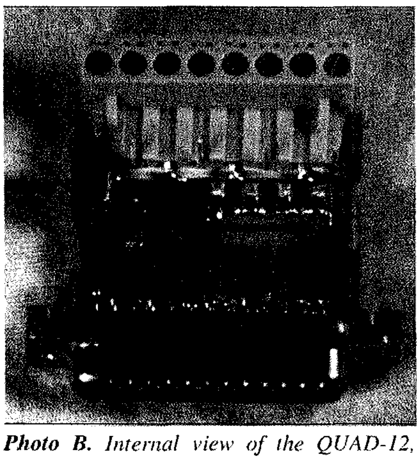

***Photo B.** Internal view of the QUAD-12, showing the surface mount soldering.*

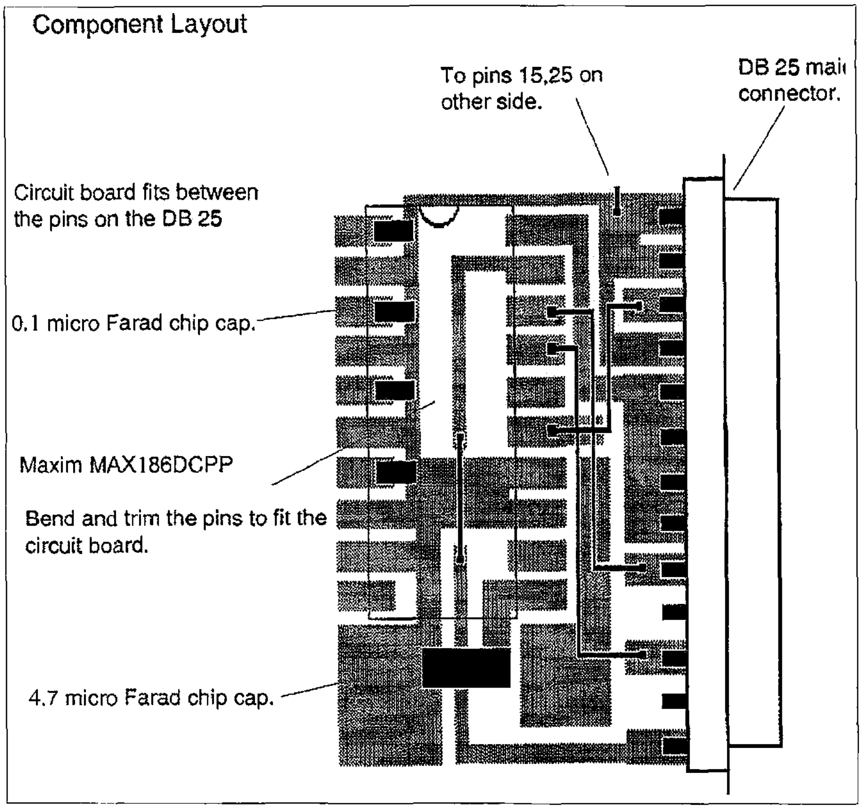

Fig. 3. Parts placement diagram.

and **4**, solder the A-D chip to the board.

Slide the circuit board between the pins of the DB-25 connector and check to be sure that the assembly fits the backshell. You may need to do some trimming. Solder the DB-25 pins to the board, filling the solder cups completely.

Solder the four connecting wires. Hold a stripped wire against the proper DB-25 solder cup and heat the cup until the wire slides into the cup. Add a little solder if necessary. Install the jumper wire under IC-1.

Using 20 gauge bus wire, connect all the ground terminals to the circuit board ground plane. The wire fits snugly in the terminal block, and no solder is required, except on the circuit board. Connect pins 25 and 15 of the DB-25 to the ground plane too.

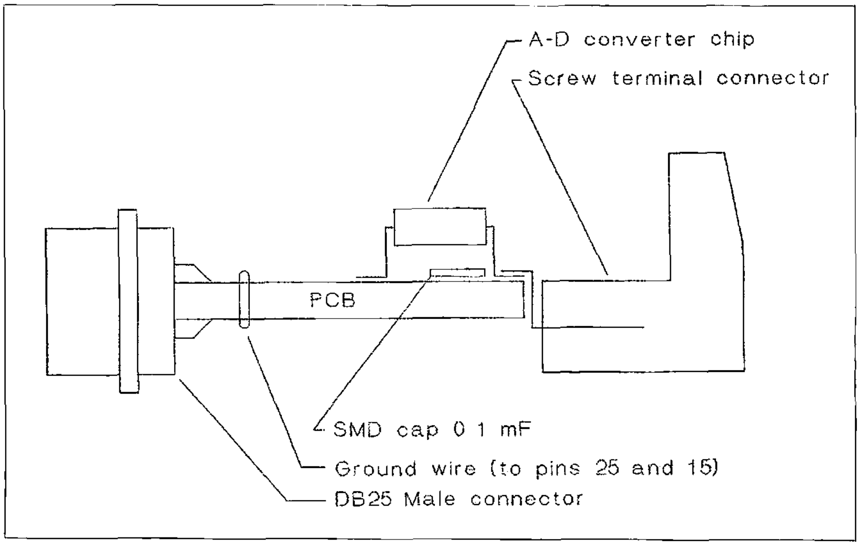

Fig. 4. Construction detail, side view.

Connect the individual input channels to the appropriate pins on the A-D chip. Refer to **Fig 1**.

After checking your work, you can give the instrument a try! Run the program listed in the sidebar, and apply a DC signal to each channel. Vary the signal amplitude from zero to 4.096 volts, and verify that an accurate conversion result appears on the screen.

If it doesn't work, change the base port address from 888 to 956. Most portable computers have the printer port at 888, but Compaq is 956. You can run a diagnostic program to find out for sure which address your computer uses (my software allows you to change the port address with a single keystroke).

With the testing complete, you can make the assembly permanent. Fill the backshell cavity with epoxy or RTV silicone. Snap the top half of the backshell in place and allow the fill material to cure overnight. The kit includes a plastic label for the terminal block. Trim it to fit in the flat the area below the terminal screws. Remove the protective backing and apply the label to the terminal block. You may need to trim any excess with a sharp knife. Once the epoxy sets, you're ready to take out your laptop and start monitoring the "outside world."

PARTS LIST

All capacitors are surface mount:

C1-C4 0.1 µF (Digi-Key # PCS6104CT)
C5 4.7 µF

Semiconductors:

IC1 (Maxim MAX186DCPP Serial A-D)

Miscellaneous:

DB-25 Male connector (Norwesco or Cinch)
DB-25 Backshell (Norwesco TT model 925M)
Circuit board (Author)
8-position terminal block (On-Shore Technology ED1707)
4 inches of 20-gauge tinned solid wire
4 inches of 22-gauge solid core hookup wire

A kit including all components and software is available for $80. The kits do *not* include epoxy or silicone. A bare circuit board is available for $3. The Datalogger software is $10, and a circuit board is included. Contact: Mike Gray N8KDD, 1680 Cooley Lake Road, Milford MI 48381; (810) 685-9248.

BASIC PROGRAM

```
port%=888                                'port%=888 for most computers.
port1%=port%+1                           'port%=956 for Compaq
port2%=port%+2
   out port2%,1
MINORLOOP:
 while not instat
  for ch%=0 to 3                         'scan 4 channels
      out port%,248                      'CS high  pin 5
      out port%,240                      'CS low
      out port%,242                      'start bit is always high DI line
      out port2%,0                       'clock high pin 1 of DB 25 printer
      out port2%,1                       'clock low

      out port%,sel2%                    'SEL 2
      out port2%,0                       'clock high
      out port2%,1                       'clock low

      out port%,sel1%                    'SEL 1
      out port2%,0                       'clock high
      out port2%,1                       'clock low

      out port%,sel0%                    'SEL 0
      out port2%,0                       'clock high
      out port2%,1                       'clock low

      out port%,242                      'UNI/BIP
      out port2%,0                       'clock high
      out port2%,1                       'clock low

      out port%,240                      'SGL/DIF  DIF selected
      out port2%,0                       'clock high
      out port2%,1                       'clock low

      out port%,242                      'PD1
      out port2%,0                       'clock high
      out port2%,1                       'clock low

      out port%,242                      'PDO (lsb)
      out port2%,0                       'clock high
      out port2%,1                       'clock low

READBITS:
       for bit%=11 to 0 step -1          'MSB is first out
        out port2%,0                     'clock high
        out port2%,1                     'clock low
        if inp(port1%)<120 then byte%=byte%+(2^bit%)
        next bit%

      if ch%=0 then sel2%=240:sel1%=240:sel0%=242:ch0volts=byte%/1000
      if ch%=1 then sel2%=240:sel1%=242:sel0%=240:ch1volts=byte%/1000
      if ch%=2 then sel2%=240:sel1%=242:sel0%=242:ch2volts=byte%/1000
      if ch%=3 then sel2%=240:sel1%=240:sel0%=240:ch3volts=byte%/1000
      byte%=0
   next ch%
   print using "####.####  ";ch0volts,ch1volts,ch2volts,ch3volts
   delay .5
   wend
```

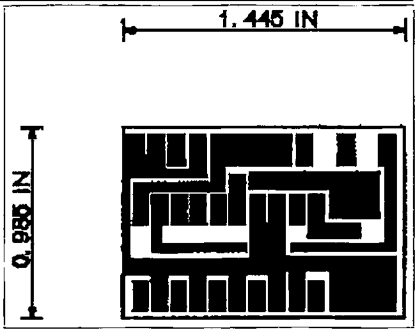

Fig. 5. Full-size PC board template.

Continued on page 27

Vee Antenna With Vertical Tails

A multiband antenna with low-angle radiation for the low bands.

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As we languish in the minimum in solar sunspot cycle. the major part of high-frequency communications is going to be carried out in the 30, 40, and 80 meter bands for the next couple of years. Horizontally polarized antennas for these bands have to be installed in excess of 50 feet in height to obtain the low angle of radiation necessary for DX work. Vertically polarized antennas, such as a quarter-wave ground-plane, are excellent for transmitting but poor for receiving on the low bands. Moreover, an excellent ground is required for ground-plane antennas to work well. If you are limited in the height of the antenna, then obtaining low angle radiation on the low bands becomes quite difficult.

Vee-with-tails design

A design that overcomes some of these limitations is the vee antenna modified to include vertical tails. The vee is an excellent multiband antenna in which two equal lengths of wire are formed in a vee configuration and fed with parallel-line tuned feeders at the apex of the vee. At low frequencies, the horizontal wires have to be fairly high in order to provide a low angle of radiation on the low bands.

In my design, the vee-beam antenna wire has vertical tails added at each end, reaching almost to the ground. These two vertical radiators behave like two 180° out-of-phase verticals fed at the top with current maximums above the ground. The horizontal wires of the vee antenna provide medium range reception, while the vertical tails provide the low angle of radiation necessary for DX. At high frequencies, the vee horizontal wires provide excellent gain and directivity.

Computer simulations of the vee-with-tails

Several different antenna designs with varying heights and lengths were simulated using the AO antenna simulation program. A wide range of lengths for the vee-with-tails were designed, based on the size of the lot available for placing the antenna. Some of these designs are listed in **Table 1**.

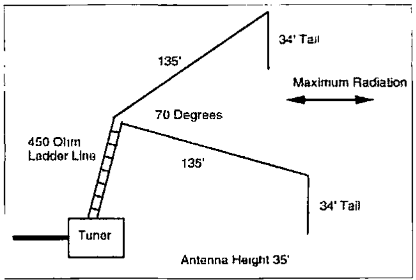

Fig. 1 The horizontal wires are 135 feet long and are formed into a vee with an included angle of 70°. Vertical tails, each 34 feet long, are added at both ends to provide the low angle of radiation from the two top-fed, out-of-phase vertical radiators. The antenna is fed with parallel wire feeders, such as 450 ohm ladder line, and matched to the transmitter with a tuner or a 9 to 1 balun. Alternatively, it can be matched with a 9 to 1 or 16 to 1 balun at the feed point and fed with coax. Different lengths and sizes of the vee-with-tails designs are shown in ***Table 1.***

The longer the horizontal wire, the more the gain at high frequencies. However, the height of the antenna becomes critical at anything over 45 feet because long vertical wires tend to radiate at high angles when their lengths become longer than one-half wavelength at the operating frequency. This basically relegates the design of the multiband vee beam with tails to antennas approximately 35 to 45 feet high. However, a design of this antenna optimized for the 80 meter band would benefit from longer vertical wires, higher antenna height, and a larger included angle between the wires. The ideal length of the vertical wires was found to be one half the wavelength at the operating frequency, though shorter lengths also work well.

Type of Antenna	Leg Length (ft.)	Vee Angle (Deg.)	Tail Length (ft.)
Author's Test Antenna	135	70	34
G5RV Vee with Tails	51	120	24 or 34
Short Vee with Tails	82	100	34
80 Meter Dipole	67	180	24

Table 1. *Some variations of the antenna designs that I've simulated on my computer. All antennas were simulated at a height of 35 feet. The length of the vertical tails can be decreased to 24 feet if necessary.*

Test antenna

I built a test antenna with 135-foot horizontal components and 34-foot vertical tails, as shown in **Fig. 1**. The total height of the antenna was 35 feet, with an included

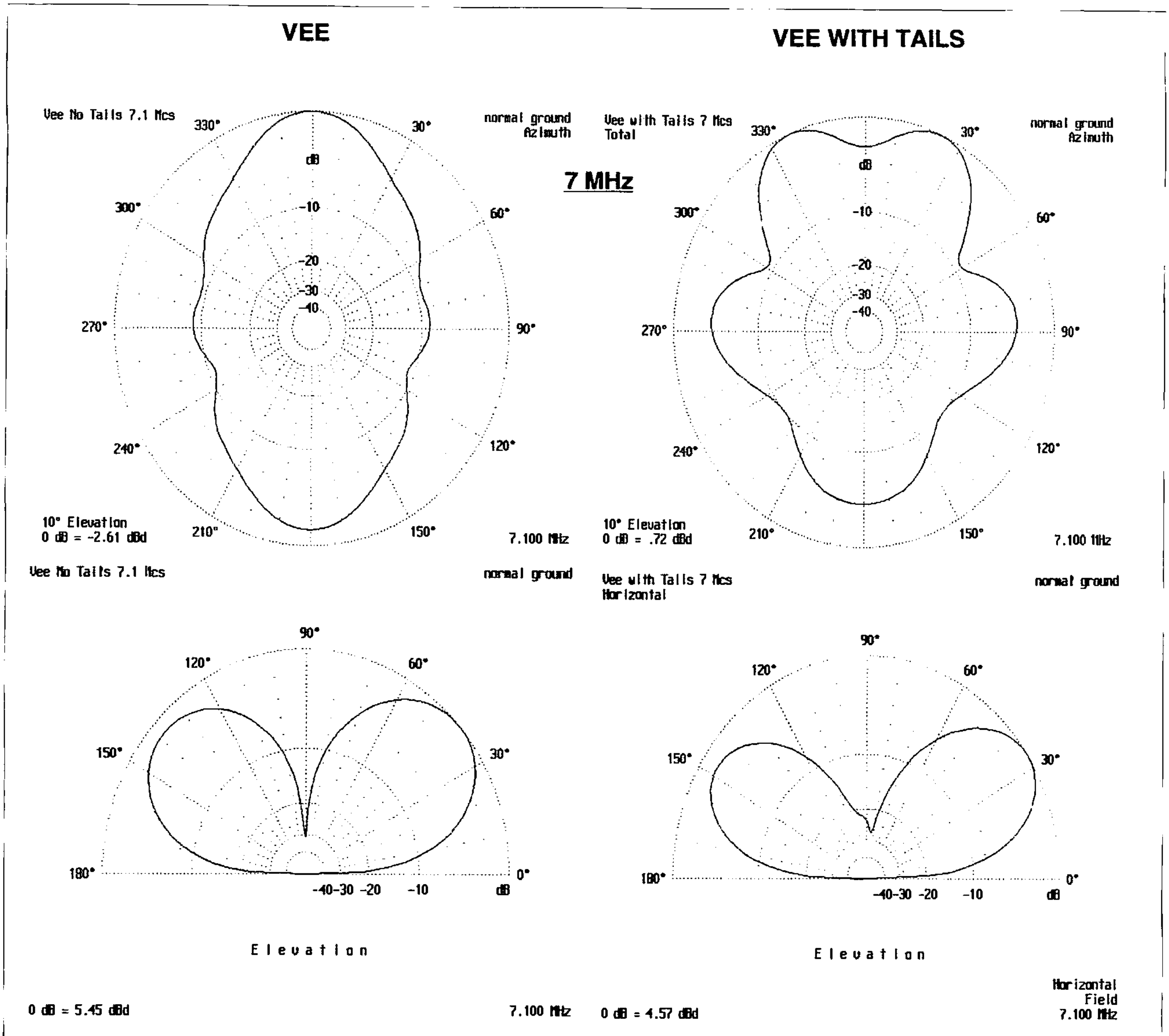

*Fig. 2. Computer generated radiation patterns for the conventional vee and the vee-with-tails for the test antenna shown in **Fig. 1**. The total field pattern is shown for an elevation angle of 10°, and the azimuth angle is chosen at the maximum point in the radiation. The angle of radiation for the vee-with-tails is approximately 10° lower than the conventional vee.*

angle of 70°. The antenna was fed with 450 ohm ladder line and a 9 to 1 balun at the transceiver. The automatic tuner in the Icom IC-738 was able to tune this antenna from 10 through 160 meters.

Final trimming of the SWR was carried out by trimming the length of each vertical wire equally. If a tuner is used between the transmitter and the 450 ohm ladder line, the length of the vee is not critical. Shorter horizontal lengths can be used, provided the included angle is made larger (see **Table 1**). Shorter vertical radiators can also be used.

"I built and tested this antenna in one afternoon with the help of my 10-year-old son."

Computer-generated radiation patterns for the test antenna

The test antenna design was optimized for the 30 meter band so it would work well from 80 to 10 meters. Computer-generated field-strength patterns comparing the horizontal vee and the vee-with-tails are shown in **Fig. 2**, for the 40 meter band. Note the broader radiation pattern of the of the vee-with-tails. The vee-with-tails has approximately a 10° lower angle of radiation due to the tails. The vertical radiation is compared to a simple ground-plane antenna in **Fig. 3,** which also shows the horizontal pattern. Note that two major lobes are formed for the vertical radiation. These combine with the horizontal radiation to provide a wide angle of coverage in the direction of the vee on 40 meters.

At high frequencies, the vertical wires radiate at high angles; however,

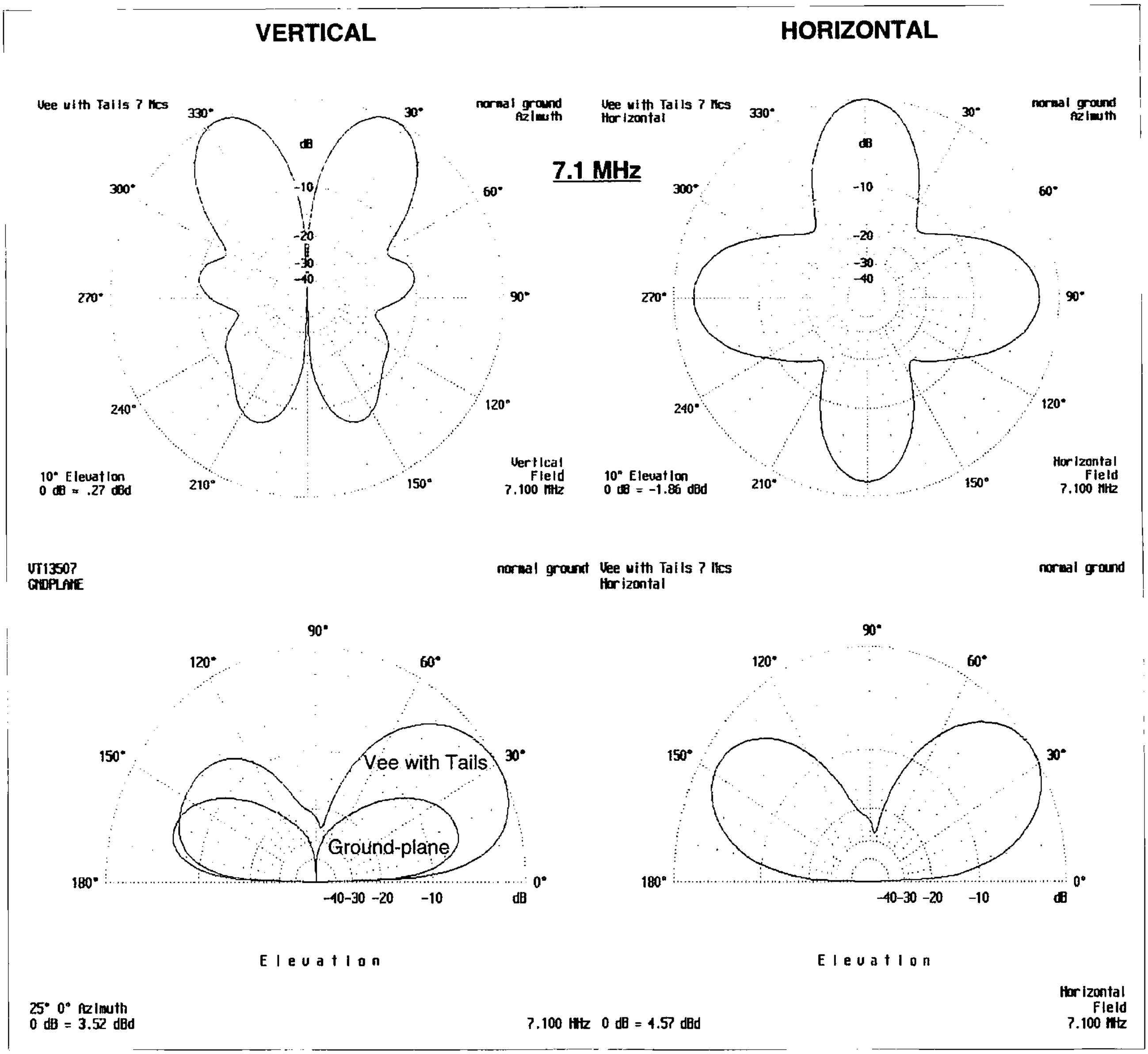

Fig. 3. A comparison of the vertical and horizontal polarization pattern for the vee-with-tails test antenna on 40 meters. The vertically polarized radiation pattern has two lobes and the major field strength is stronger than the ground-plane radiation in the direction of the vee. The ground-plane radiation pattern is superimposed on the vertical elevation graph.

the horizontal vee provides a fair amount of gain to compensate for the loss from the vertical radiators.

Fig. 4 shows the computer-generated radiation patterns for the 20, 15, and 10 meter bands. The patterns are equivalent to a three-element beam at low heights. And, even though the 17 and 24 meter data are not shown, the antenna works quite well on these bands too.

On 80 meters, the radiation pattern is dominated by the low height of the horizontal wires, which puts most of the radiation at a high angle. However, even at this low height, some low angle of radiation takes place on 80 meters, as shown in **Fig. 5**. Note, however, that the maximum radiation pattern for the vertical components in the 80 meter band is at right angles to the direction of the vee. At this frequency, the two out-of-phase vertical radiators are separated by approximately one-half wavelength and the maximum radiation pattern is in line with the two vertical elements.

"I've had a lot of fun with this antenna, especially since it is concealed among my trees and the neighbors don't even know that it exists."

Test results for the vee-with-tails

The test antenna has been used for two winters and in several contests. It was tested against a quarter-wave trap vertical antenna with ground radials as a standard. In the optimum direction of

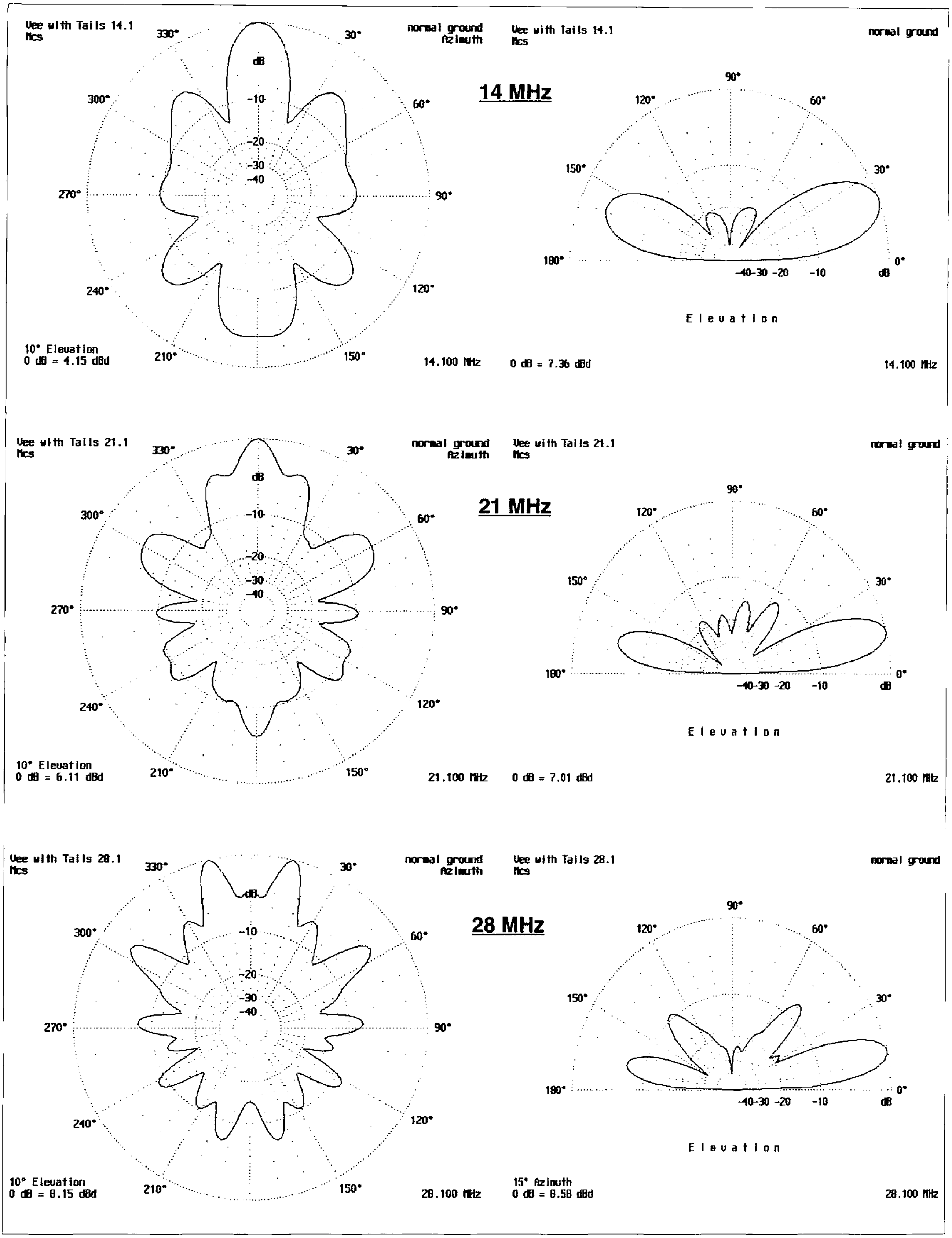

Fig. 4. Computed field strength patterns for the antenna on the 20, 15, and 10 meter bands. These radiation patterns are very similar to a vee without tails, except that the gain is slightly lower for the vee-with-tails due to some high angle radiation at these frequencies from the vertical radiators.

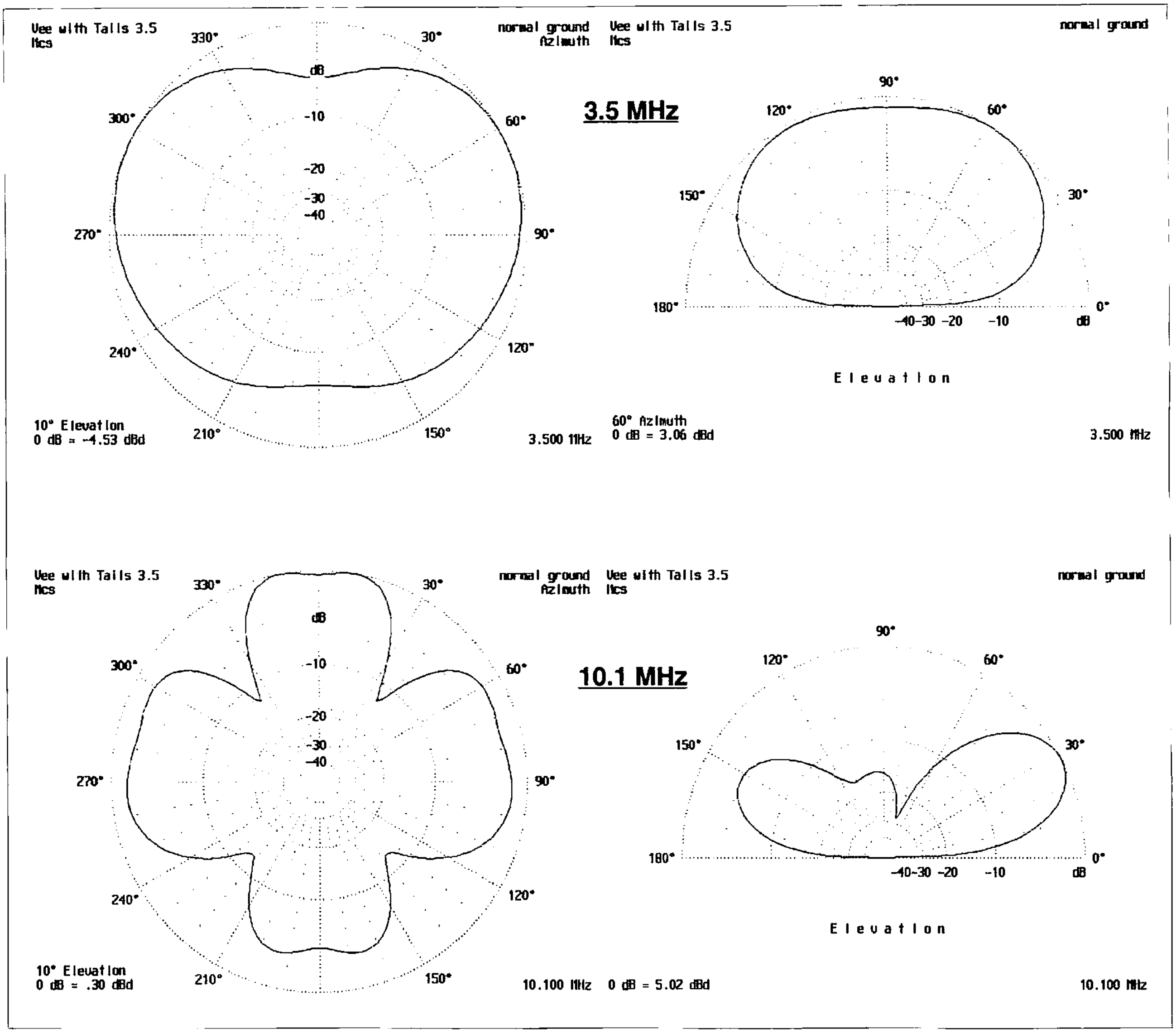

Fig. 5. Computed field strength patterns for the antenna on the 80 and 30 meter bands. Note that the maximum radiation on 80 meters occurs at 90° to the direction of the vee.

the vee antenna, which is north-northeast from Houston, Texas, this antenna consistently outperformed the vertical by two or more S-units on 40 meters. Received signal strengths at the other stations were also compared for the vertical and the vee beam with tails. Again, in the direction of the vee, the beam with tails performed two or more S-units better. Fading was reported to be much less, both for the received and transmitted signals, partly because of the mixed horizontal and vertical polarization of the antenna. QRP operation with 2 watts on 40 meters was a snap into the northeast United States and Mexico, with 579 signals. Signal strengths at 90° to the orientation of the vee were better for the ground-plane antenna than for the vee-with-tails.

Working contests was also quite easy with this multiband design. I worked most of the European and North American stations that I heard. On 20 meters, the antenna could not compare to the big yagi antennas on tall towers. However, it consistently put out a very strong signal into the northeast and Europe, comparable to a triband-type yagi antenna at a low height. During a couple of contests, when the 15m band was open to Europe, the antenna put out a very strong signal. On 80m the maximum vertical radiation is 90° from the direction of the vee. South American contacts were 579 with 100 watts, while short-skips to the US provided strong signals. I even loaded up the antenna on 160 meters during the last contest and worked 25 states in a couple of hours.

Conclusions

Considering that this antenna is designed for multiband operation and is only 35 feet off the ground, it works remarkably well. The antenna is easy to build and the tails can be adjusted for the best compromise in SWR across the bands. I built and tested this antenna in one afternoon with the help of my 10-year-old son, Ethan. The 9 to 1 balun can be replaced with an antenna tuner if desired. It is also possible to place a 16 to 1 ratio balun at the feed point and run 50

ohm coax to the tuner. A 16 to 1 balun provides a better match overall if the 450 ohm ladder line is not used.

The only critical parameter in the antenna design is the angle of the vee; that's what determines the radiation pattern at different frequencies. The shorter the horizontal length of the antenna, the greater the included angle in the vee should be. As an example, the G5RV version of the vee beam with tails has 51-foot horizontal wires with 34-foot vertical wires, and an included angle of 120°. This design works quite well on 40 and 80 meters and provides some low-angle of radiation that is not available from a conventional G5RV oriented in the horizontal direction.

The vee is very simple to construct if you have some trees in your back yard. There are several variations of the lengths and angles for this antenna which can accommodate different sized lots. The critical thing in the construction is to keep the two sides of the vee the same length. And, since wire antennas are more susceptible to damage, record the SWRs on all the bands for future reference. This way, if you suspect some damage you can easily check it with an SWR measurement.

I've had a lot of fun with this antenna, especially since it is concealed among my trees and the neighbors don't even know that it exists.

References

1. *The ARRL Antenna Handbook*, 1995
2. AO and NEC programs published by Brian Beezley K6STI.

Build the QUAD-12

Continued from page 15

Data Acquisition

The science of data acquisition is a subject in itself, but we can cover the basics in a few words. In digital data acquisition, you need to be most aware of what **NOT** to do.

1. *Don't damage your instrument.* Never apply a voltage greater than the A-D chip can resolve. In this case 4.096 VDC. The chip can actually handle greater voltages, but it's always a good practice to stay within design limits.
2. *Don't forget the Nyquist theorem.* Set the sample interval to least twice the highest frequency you expect to see. If you don't, you may be sampling only peaks or valleys.
3. *Don't lose data.* Write data only to a RAM disk or hard drive. Floppy drives are slow and you may miss a record or ruin your time base during disk writes. Floppy drives should be fast enough for sample intervals greater than 3 seconds.
4. *Don't let unused input pins float.* Connect unused channels to ground. Generally speaking, high input impedance is a good thing because the measurement system doesn't load the system under test. An open channel is measuring the electrical potential of the air, with respect to the ground plane of the computer. It's possible for high voltage on an open channel to affect an adjacent in-use channel.

PC-Controlling Your Rig

All it takes is a few parts and a BASIC program.

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8330 Myers Lake NE
Rockford MI 49341

I suspect there are a lot of Kenwood TS-50 owners who, like me, use this radio at home as much as they do in their cars. For its size, the radio packs in a lot of features, but one is missing: a way to enter frequency directly from a PC.

Like many current rigs, the TS-50 includes provisions for connecting a computer for direct frequency entry capability, but I didn't like their approach because it requires an outboard box with a cable coming out through the bottom of the radio. That's not my idea of something portable. The ideal would be to use a portable computer and a cable that easily connects to the rig, with no other baggage necessary. I accomplished this using a notebook computer with an easily built in-line interface and a simple control program.

Tying into the radio

After studying the TS-50's schematic, I could see that it was essentially computer-ready. The microprocessor used in the '50 is one of the newer breed of microcontrollers that include a UART (Universal Asynchronous Receiver-Transmitter) built in. **Fig. 1** is a partial diagram showing the TS-50's computer interface circuit details. In implementing computer control for this radio it looked as if I'd have to add some buffering, level conversion, and signal inversion, and come up with some scheme so that I could connect to "CN6," as shown in **Fig. 1**. CN6 is the serial data interface connector, and supplies TX and RX data, handshaking, and a 5-volt power source.

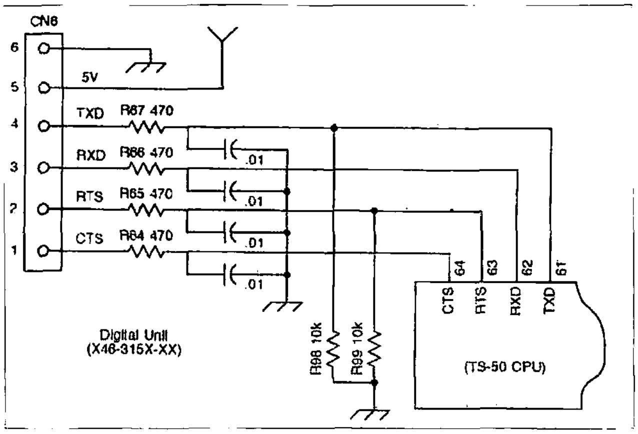

Fig. 1. Partial diagram showing the control computer interface circuits.

The rear panel of the TS-50 didn't leave room to add a new connector, but I noticed that the heat sink was tapered at the top rear on either side, leaving enough room to sneak a 1/8-inch cable out the back. This would let me hook up some type of in-line connector with which I could connect my computer. **Photo A** shows the 1/8-inch, three-circuit mini-phone type connector I used.

Photo A Rear panel view showing the added computer interface cable and connector.

I had easily passed the cable out of the radio, but I still had to make a connection at CN6 on the radio's microprocessor board. CN6 appears to be what I call a "mini-header connector," and finding anything that would mate with it in my neighborhood proved impossible. If you can find a mating connector, I would recommend using it—I decided to go without a connector. **Photo B** shows the technique I used to connect to CN6.

At first, I considered soldering wires directly to the circuit board points at CN6 (this is an option), but, in keeping with my preference to make no mechanical modifications (and possibly void any warranty), I elected to take a somewhat unorthodox approach. I selected three lengths of #22 stranded hookup wire that were long enough to run from CN6 to the rear of the radio. I then cut the CN6 ends of the wire square and carefully bored holes into the ends of each wire using a straight pin (see **Fig. 2**). The wires were then pushed over the appropriate pins of CN6, as shown in **Photo B**.

To complete the installation, I cut a small rectangle of electrical tape and carefully stuffed it between my wires and the inside of the connector's plastic shell, sticky side out (using a small screwdriver). This tape wedge provides a slight amount of "spring tension" to push the wires against the CN6 pins for good electrical contact, and it acts as an adhesive to hold the wires into CN6. Should I ever want to de-install this "modification," I'll simply pull the wires and tape out of the radio, leaving no traces of any work I've done.

I routed the wires through a small chassis opening adjacent to CN6, to the outside along the right side of the radio, and finally out the rear near the top right of the radio. To protect the wires, I ran them inside a piece of 1/8-inch diameter plastic tubing for added insulation. This is not essential, but it's a good idea to use electrical tape or something at potential "pinch-points." Outside the radio, I terminated the wires with a 1/8-inch diameter three-circuit female in-line mini-phone jack, wired per **Fig. 3**.

Check carefully to make sure there are no straggling wire strands anywhere, especially down inside CN6, since it also carries +5 VDC and ground. I used a magnifying glass and made ohmmeter checks to make sure I didn't have any problems. Also make sure the cable is tied off properly to prevent strain from being transferred to CN6.

The level converter interface

I decided to do a three-wire RS-232 implementation, even though the TS-50 supports hardware handshaking via RTS and CTS at CN6. The main reason was so I could use that small, unobtrusive connector outside the radio. Also, it kept the interface simpler, and I wanted an "in-line" device. **Fig. 3** is a diagram of the level converter interface design I developed for the TS-50, together with interconnecting wiring details. **Photo C** shows how I built it as an in-line device, part of the interconnecting cable between my computer and the TS-50.

Having done a similar interface to another type radio, I was a bit concerned about the lines from CN6 in this radio because they run directly to the radio's microprocessor—no buffers or the like (see **Fig. 1**). Any static discharge or improper voltage that came in on my cable

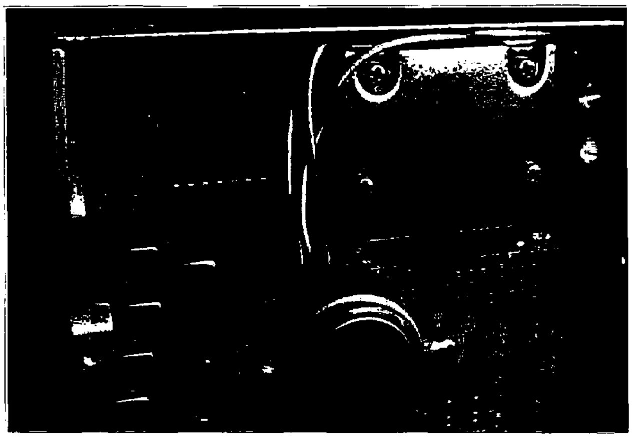

Photo B. Direct connection technique used with "CN6" on the microprocessor board (see text).

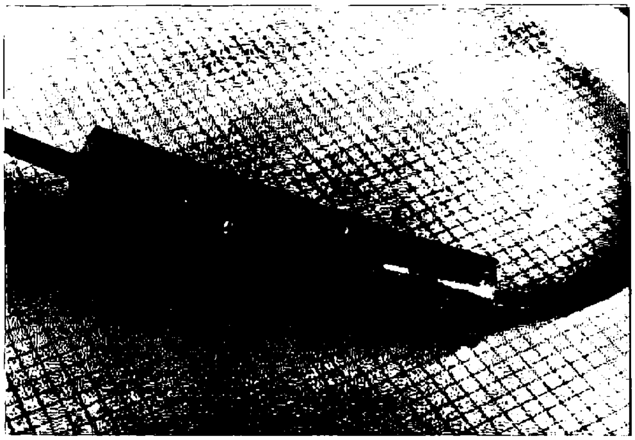

Photo C. Construction details of the RS-232 interface cable.

could do serious damage. To make this installation a little less static-sensitive, I decided to add a 10k pull-down resistor to the RxD line, similar to the one on TxD. I installed this resistor inside the shell of the mini-phone jack from the radio, as shown in **Fig. 3**. Too bad they didn't include a pull-up resistor at RxD inside the radio; it would have made my level converter design easier.

Even though +5V is available from the CN6 connector, I decided to get operating power from the computer via the DTR line. I did this to minimize the number of wires needed from the radio. Since the DTR line from my computer sits at some negative voltage level when not active, I used a diode to prevent reverse polarity powering of the interface during these periods. A second diode is similarly used in the computer's TxD line to keep the logic "positive going."

My computer's RS-232 levels (I use a Compaq™ notebook for my radio applications) vary between ±10 volts, so I designed the interface around a +10 volt supply. To assure proper operation should I want to use the interface with some other computer with higher levels (RS-232 levels can be as high as 25V), I added a 10-volt zener diode. Since my computer is battery operated a lot of the time, its RS-232 levels often drop to 7V or so as the battery discharges, but this doesn't seem to affect the operation of the interface.

The level conversion technique used in this circuit is essentially a couple of open collector switched resistance voltage dividers as pull-ups for the radio and computer RxD lines, with a few extra components added to insure adequate protection for the radio. I used 2N2222 type transistors for my interface, but any similar device would work. Since the TS-50's data rate is fixed at 4800 baud, a device with good switching characteristics should be used for satisfactory operation at this moderately high rate.

I used the maximum value pull-up resistor value (15k) that would work reliably for the computer RxD line's circuit to minimize current drain. Since I added a 10k pull-down resistor to the radio's RxD line, I needed a circuit that wouldn't exceed the TTL limit of 5 volts in the event my added pull-down resistor failed, yet would still give a reasonable TTL high level with it in. As a precaution I added a zener diode to clamp this level to a maximum of 5.1 volts. My TS-50 seems to operate fine with RxD levels as low as 2.5 volts (remember my battery) with this interface, and the zener reassures me that I won't hurt my radio.

TxD from the radio is coupled to the switch transistor base using a 27k isolation resistor, and it is

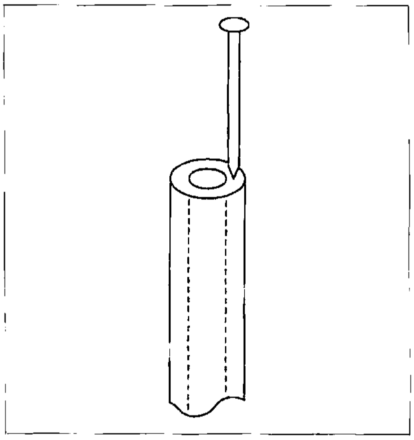

Fig. 2. Boring the end of a piece of hookup wire with a straight pin to allow connecting to CN6.

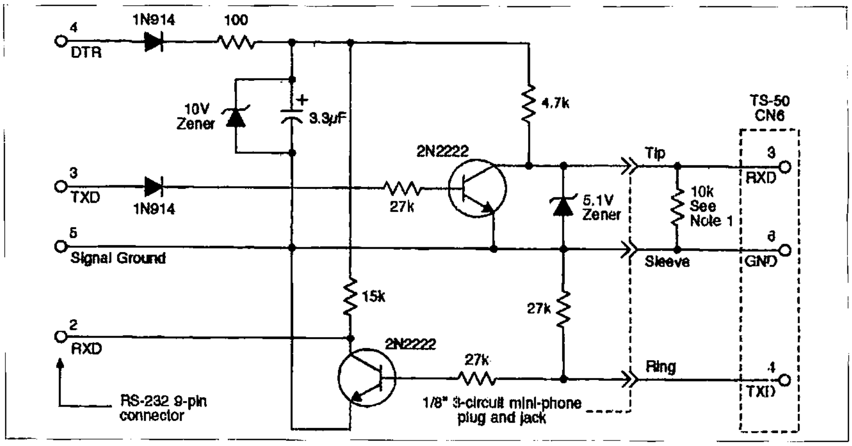

Fig. 3. The RS-232 level converter circuit and interconnect wiring details. Notes: 1) 10k resistor installed inside mini-phone jack cell. 2) All resistors 1/4 watt.

loaded by a second 27k to signal ground. In a like fashion, the computer TxD is also coupled through another 27k resistor and a diode to prevent reverse bias of the switch transistor.

Construction

The level converter interface circuit is built on a 1/2-inch by 1-1/4-inch piece of perf board to fit inside a 1/2-inch diameter piece of plastic tubing, as shown in **Photo C**. The component layout is not critical, other than placing them on the board in a low profile manner such that the whole assembly will fit inside the tube.

The tubing serves as an enclosure for the interface and as a strain relief for the cables. I secured the cables to the tubing with tie-wraps inserted through slits I cut into the tubing.

The circuit wiring is point-to-point, with jumper wires connecting the points as required. I used Teflon™ wire because it was available, but any good hookup wire will work. I attached the interconnecting cables by directly soldering the individual wires to their connect points at the perf board.

Because of the potential to emit RF noise, some special attention should be paid to RS-232 cables. I used shielded wire for both the computer cable and the cable to the radio. The computer cable is a four-conductor shielded type, and I connected the shield to one of the wires at the computer connector end only, letting the shield float at the interface board end. Similarly, the radio link cable has its shield connected to a wire at the plug end only. I did not use shielded wire inside the radio because the majority of it is run between the radio chassis and cabinet. Also, I used the ground connection at CN6 only, as a single-point ground at the radio to avoid any possible "ground-loop" problems.

Preliminary checkout

I would suggest making a few continuity and resistance checks to verify your wiring before plugging the interface in. Once you're satisfied everything is wired correctly, preliminary tests can be made by connecting the interface cable assembly to your computer's COM port and bringing up a communications program. I used the terminal program bundled with Windows©,

CIRCLE 276 ON READER SERVICE CARD

configured for 4800 baud, eight data bits, no parity, two stop bits, and software flow control.

With the communications program properly configured and the interface cable plugged into the computer, you should measure +3 to 5 volts between the radio plug sleeve and ring, and zero volts between the sleeve and tip. If you then short the tip to the ring, and hit a few keys on the keyboard, you should see these characters echoed on the computer screen, indicating the interface is functional.

Once the interface is verified as functional, you can connect it to the radio. I recommend connecting and disconnecting with power off at both the computer and radio, but I have hot-connected the interface with no harm. Once connected, and with the communications program configured as previously described, try typing "IF;" (use uppercase letters and don't use the quotation marks). The radio should reply with a string of data similar to that shown in **Table 1**. If this works, you have verified that the interface is working and capable of sending and receiving data to and from the radio.

Control software

Kenwood Radios are perhaps the easiest to write control software for because command and data formats are in ASCII text format. This means you can use a standard terminal program, such as that bundled with Windows, to send commands and display data, although a custom program to enter and display data in a more user-friendly format is much nicer to use. The TS-50 uses a subset of commands that many Kenwood radios use, and I have included those I am aware of in **Table 1**. For those who wish to experiment in writing their own custom control program, I have included a QBasic listing of a program for entering and displaying frequencies in the sidebar, as an example of how easy such programs can be.

Direct Frequency Entry & Display Program for the TS-50

TS-50TST.BAS

Sample QBasic Frequency Write and Display Program for the Kenwood TS-50. (This program was tested on the TS-50 using a Compaq Aero Notebook Computer 11-30-95.)

```
OPEN "com1:4800,n,8,2,cd0,cs0,ds0,op0,rs,tb1024,rb1024" FOR RANDOM AS #1
SCREEN 1 'set up the big screen

PRINT #1, "FA;"; 'get initial frequency

WHILE w = 0 'start the main loop
 IF LOC(1) > 10 THEN
 CLS
 LINE (75, 70)-(250, 100), , B 'draw box around freq. display area
 ip$ = INPUT$(LOC(1), #1) 'transfer com buffer data to input string
 END IF

IF LEN(ip$) > 13 THEN 'update frequency display
 freq$ = ip$ 'make sure enough data gets transferred
 i = LEN(freq$)
 LOCATE 12, 15
 PRINT MID$(freq$, 6, 2); 'display megahertz
 PRINT "."; 'put in the dot
 PRINT MID$(freq$, 8, 3); ","; MID$(freq$, 11, 3); 'kHz & Hz
 PRINT " MHz";
 ip$ = ""
 LOCATE 2, 2: PRINT "TS50 Frequency Control Program - K8KWD"
 LOCATE 24, 1: PRINT " f-key to Enter Frequency ";
 LOCATE 25, 1: PRINT " Q-key to Exit ";
 END IF

 b$ = INKEY$ 'scan for keyboard inputs
 IF b$ = "f" THEN 'we want to do a frequency write
 LOCATE 5, 10: PRINT " ": LOCATE 5, 10
 LINE INPUT "Enter Freq MHz.kHz "; c$
 d = INSTR(c$, ".") 'figure out where decimal point is
 IF d >= 1 THEN 'add a little trap for garbage keyboard entry
  'build the command string for frequency write
 m$ = LEFT$(c$, d - 1): k$ = MID$(c$, d + 1) 'split MHz & kHz
 IF LEN(m$) = 1 THEN hdr$ = "FA0000" ELSE hdr$ = "FA000"
 IF LEN(k$) = 0 THEN tl$ = "FA000000;"
 IF LEN(k$) = 1 THEN tl$ = "00000;"
 IF LEN(k$) = 2 THEN tl$ = "0000;"
 IF LEN(k$) = 3 THEN tl$ = "000;"
 IF LEN(k$) = 4 THEN tl$ = "00;"
 IF LEN(k$) = 5 THEN tl$ = "0;"
 IF LEN(k$) = 6 THEN tl$ = ";"

 LOCATE 6, 20: PRINT " ": LOCATE 6, 20
 PRINT #1, hdr$; m$; k$; tl$;
 hdr$ = "": m$ = "": k$ = "": tl$ = ""
 FOR i = 1 TO 4096: NEXT i 'add a little recovery delay
 END IF
 PRINT #1, "FA;"; 'update freq display
 END IF 'end of if freq write

 IF b$ = "Q" THEN w = 1 'that is all folks
 WEND

 {TS50DF1.DOC}
```

Table 1. Miscellaneous TS-50 Commands and Data Formats

Command	Data Format
General Format	All commands are in upper case letters and are terminated with a semicolon (;). Many commands are dual function—they can be used to read and to write data.
FA;	Returns current VFO A Frequency as: FA00003976000; for example. The frequency data is in an eleven digit format with the left most digit representing the 10 GHz value, and the right, the 1 Hz value. This example translates to a frequency of 3.976 MHz.
FA{data};	Writes a frequency to VFO A. Note that there are 11 data digits that must be filled (using zeroes as appropriate) for this command to work. It's possible with the TS-50 (and I suspect other Kenwoods) to write frequencies to 1 Hz resolution.
FB: and FB{data};	Same as FA; and FA{data}; as described above except these commands read or write frequency to VFO B.
FN{Cmd Code};	Function command, sets VFO A/B or Memory: FNØ; = VFO A FN1; = VFO B FN2; = Memory Mode
ID;	Returns Radio Identification Number: IDØ13; (for the TS-50)
MD{Cmd Code};	Mode Command, sets Communications Mode: MD1; = LSB MD2; = USB MD3; = CW MD4; = FM MD5; = AM MD6; = FSK
RX;	Commands Radio to receive (see TX command).
SP{Cmd Code};	Sets Split Mode on or off: SPØ; = OFF SP1; = ON
TX;	Switches Radio to transmit. Once sent, the radio remains in transit until the RX; command is sent (or power off).
IF;	Returns current status in a 35 character string such as: `IF00001850000      -015000 0701000     ;` where the first eleven characters represent frequency in the same format as 'FA' above. Characters 12 thru 16 are not used. Characters 18 thru 21 represent RIT frequency in Hz, with the 17th giving the direction as plus (+) or minus (-). Characters 22 and 23 indicate RIT/XIT status respectively; a zero = off, a one = on. Character 24 is not used. Characters 25 and 26 indicate Memory Channel number. Character 27 indicates whether the rig is in receive or transmit; zero = receive, one = trânsmit. Character 28 indicates current mode (see mode command above). Character 29 indicates function similar to function command described above. Character 30 indicates whether scan is on or off; zero = off; one = on. Character 31 indicates if split mode is on or off; again, zero = off, one = on. Characters 32 thru 35 are undefined.

Worthy of Recognition: Hap Holly KC9RP

Blindness is a challenge for this versatile, accomplished ham.

Dave Miller NZ9E
7462 Lawler Ave.
Niles IL 60714-3108

In the March 1996 issue of *73*, Wayne Green asked readers to consider generating some articles on fellow hams who they felt deserved acknowledgment before they became Silent Keys and were recorded only in memory. It's easy to recount an individual's achievements after he or she is gone, but if someone is doing something worthwhile, don't those deeds deserve recognition while the person is still around? I think so, too.

When Uncle Wayne wrote about it in his editorial, I immediately thought of a friend of mine, someone who's overcome a great obstacle to become recognized as doing something worthwhile each and every week for the amateur radio community; Hap Holly KC9RP, founder, guiding light, and moderator of the weekly amateur radio audio feature magazine known as RAIN—the Radio Amateur Information Network.

RAIN

From his home studio/ham shack in suburban Chicago, Hap produces his 12 to 17 minute weekly amateur radio program service, featuring timely interviews, thought-provoking commentaries from other hams (yours truly included), excerpts from Dayton Hamvention Forums, and other items of general interest to the amateur community at large. Ham radio is traditionally an aural—as opposed to a visual—medium; we meet and recognize fellow hams primarily by voice, seldom seeing them in person. RAIN programming is also an aural medium, distributed to hundreds of repeaters across the country via the RAIN dial-up line, commercial satellite, Hap's subscription service on audio tape, and WAØRCR's weekly 160 meter informational broadcasts. Those repeater groups, and others, then replay the weekly RAIN tapes over their local repeater systems on their regular "net night" gatherings, permitting thousands of hams to hear Hap's offerings for that particular week. It's all done with volunteer help and, in the best of amateur traditions, without profit to anyone involved.

Hap Holly makes it happen; he's an uncommonly intelligent and outgoing individual. Hap is also very aurally oriented and insists on quality in every way in his RAIN programming. He conducts most of the interviews, edits and engineers all of the program material, writes the scripts, duplicates and mails out the RAIN cassettes, and archives and catalogs the RAIN library. It's all accomplished by touch and by ear. Hap is one of a number of non-sighted amateurs within our ranks, but you'd never know it.

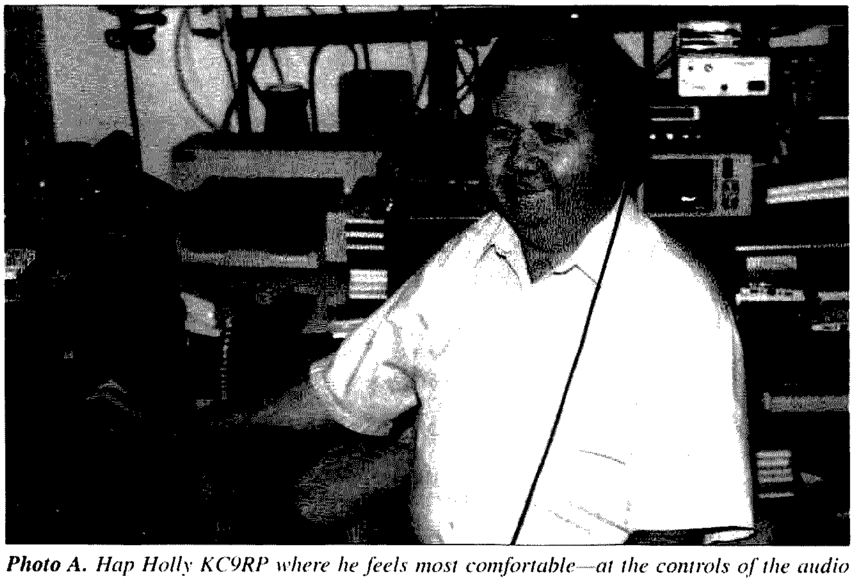

Photo A. Hap Holly KC9RP where he feels most comfortable—at the controls of the audio board, where he puts together his weekly RAIN amateur radio audio magazine show, and

Hap's history

For Hap, blindness came literally overnight when he was only seven

years old. Problems with his vision began when he was four, but then he awoke one morning totally blind. The condition is untreatable, at least within current medical terms, but to Hap, it hasn't been a handicap. In fact, in talking to him over the years, most of his friends tend to forget his unusual challenges because he does so much of what we all do, without mention of his visual impairment.

Both of Hap's parents were blind. His father's vision loss resulted from a football accident in college, but Hap's dad still became a successful building contractor and architect, formulating the plans he devised within his "mind's eye," then describing the details precisely to his secretary, who constructed balsa wood models. Then, only by touch, he would go over the "three-dimensional plans," incorporating additions or changes as needed. Hap's father was also a longtime columnist for the *Christian Science Monitor* and was known worldwide for his "Ask a Builder" column, which he wrote from 1965 until his passing in 1984. He was a touch-typist—as is Hap—and was able to generate his column by that method alone (before the days of computers, word processors and voice synthesizers).

Hap's mother lost her sight when she was around twelve years old. A 1988 book about her life, titled *What Love Sees*, depicted her struggle for independence from her New England industrialist father, her marriage to Hap's dad, and the eventual challenges that two sightless parents encountered raising four sighted children—then Hap, too, became blind. The book is being made into a made-for-TV movie this year, which will be shown on the CBS television network when completed. It will star Richard Thomas of the original "Waltons" series, and Annabeth Gish, who played Pat Nixon in the widely acclaimed motion picture "Nixon." The TV movie, which is also called "What Love Sees," primarily takes place in the small Southern California ranching town of Ramona (where much of it was filmed), and reportedly follows the Holly household up until shortly

after the time that Hap's sight was lost and the family was forced to move to a larger city—Escondido—to seek specialized educational opportunities for their youngest son. Hap was able to spend a few hours with the movie company as they were shooting the film, meeting with and talking to the actors, including the eight-year-old boy who portrays the "young" Hap Holly. Be sure to watch for "What Love Sees" this October on CBS. The original book, from which the movie's script was developed, is scheduled for reprinting this summer, in large print form from Thorndike Press, for readers with visual handicaps. Also in the works is a proposal for a "talking book" version of the original book to coincide with the publication of the large print edition.

Hap's ham career began when he earned his Novice ticket in 1965, at the age of 14, receiving the callsign WN6UJH, while living in Escondido. He became a General—dropping the "N" in his call—a year later, in 1966, and served as a phone-patch station and net control for the Westcars traffic net until 1970. Hap then headed off to Principia College in Elsah, Illinois. From 1970 until his graduation in 1974, he ran phone patches and kept radio schedules for his fellow students. He graduated with a Bachelor of Arts degree in sociology, and soon found himself in the Chicago area, where he sought out world-class jazz accordionist Leon Sash, to pursue his other love, music. A year later, another love, Stephanie, became the center of Hap's attention and the two were married in August of 1976. They had met the previous summer at the Roundup Ranch in Buena Vista, Colorado, where Hap was a counselor. He taught a class in non-visual perception to the high school campers at the ranch, all of whom were sighted, but who learned to "see" in yet another way, with Hap's patient guidance. Hap's wife, Stephanie—who is sighted—received her ham ticket and the call KA9WKD in 1986 after realizing how much ham radio, and the good it was able to accomplish, meant to Hap.

In 1977, Hap picked up the "9-land" call of WD9GJQ when he and Stephanie moved into their comfortable home in Des Plaines, Illinois, where he resumed his phone-patching and DXing activities with his now permanent antenna and station setup. In 1981, Hap passed his Advanced Class license exam and changed calls once more, this time to his current KC9RP callsign.

I met Hap when he served as ham radio informational programming guru for the BEAR, the Broadcast Employees Amateur Repeater in suburban Chicago, from 1984 to 1989. Hap's weekly "net nights" became something of a legend in the Chicago area, sometimes attracting in excess of 100 check-ins, via simulcasts on five area repeaters. This stint led to Hap's forming RAIN and the weekly RAIN Dial-up, the RAIN Monthly audio tape and the bimonthly RAIN Journal tape (produced especially for blind amateurs). According to Hap, "My inspiration for producing weekly ham radio programming resulted from my need to know. I faithfully listened to the weekly Newsline (formerly WestLink Radio) reports in the early 1980s on my local repeater. I owe a great deal of gratitude to Newsline's founder and producer, Bill Pasternak WA6ITF, for his encouragement and direction. RAIN is truly an offspring of Newsline, but with a human interest focus, as opposed to a news-only approach."

As mentioned before, Hap's RAIN programming can now be heard on hundreds of ham repeaters across the nation, or by calling 847-827-RAIN*. Vern Jackson WAØRCR also carries the RAIN Dial-up on his 160 meter Gateway Radio Newsletter AM bulletin service from Wentzville, Missouri, on 1.860 MHz several times each week.

In recent years, Hap has written for *Spec-Com Journal, Radio Scan Magazine*, and, occasionally, reports for Newsline. He's a common sight at the yearly Dayton Hamvention, taping a number of the forums with the help and cooperation of the Hamvention organizers. Excerpts of these forums are then incorporated throughout the year in Hap's RAIN programming, making Dayton come alive for those of us who may not have been able to attend personally.

Hap is also active on HF, VHF, amateur radio packet, and now the Internet, using his Versa-Braille II Plus terminal. The Versa-Braille allows an accomplished Braille reader like Hap to "read" the packet bulletins and to access his Internet E-mail with nearly the speed of a sighted user. He's also working with his 386 computer and a standard keyboard, in conjunction with a speech-output device.

As a professional keyboardist, Hap's diverse repertoire of music from the last 60 years has made him a popular choice for Chicago area musical engagements. He's also an active and honored member of the Des Plaines Lions Club and received their prestigious international Melvin Jones Fellowship plaque for his service to humanity. As a member of the Des Plaines Toastmasters, Hap has served as its president several times, and has twice served as an area governor.

For Hap Holly, blindness has never been a disability, only a challenge that has served to "fine-tune" his other senses. If you have a friend or relative with a serious handicap or disability, and you've felt that amateur radio would be a worthwhile hobby for them to pursue, perhaps Hap's extraordinary story might be just the inspiration they would need to take the plunge. Hap would disagree with my choice of terms (extraordinary) since he considers his accomplishments no more than the expected effort required to achieve anything worthwhile—but then that's the signature of extraordinary people, isn't it?

Hap's RAIN Dialup can be accessed by calling 1-847-827-RAIN (7246). Hap's Internet E-mail address is hholly@ais.net. His amateur packet address is KC9RP W9ZMR.EN52VA.IL.USA.NOAM. RAIN's mailing address is RAIN, P.O. Box 2565, Des Plaines IL 60017-2565. Hap can receive voice-mail at 1-847-518-6551

NEVER SAY DIE
Continued from page 4

not many attendees ventured. Several hams with "Staff" hats on came by my booth, but none said anything about it being nice that we were there. None offered any help. There was no area set aside for exhibitors to rest or get a cup of coffee. We all had to either queue up to the single commercial food supplier and buy our lunch or go hungry. I looked at the long line a few times and went hungry. Not that the menu or the high prices were attractive.

I did enjoy talking with old friends and we sold a handful of subscriptions.

Dayton is successful because they have an experienced team running it. The Atlanta HamFestival did not pursue me to talk far enough ahead for me to alert the *73* readers who enjoy my talks and get them to come. That can usually bring in a few hundred loyal fans.

Some of the hams I talked with had also attended Dayton a few weeks earlier. Now, if Dayton can bring 'em in from Georgia, obviously a well-run and promoted show in Atlanta should be able to haul 'em in from Dayton. And should be attracting ham caravans from Missouri, Arkansas, Louisiana, and so on.

These days, with the hobby in a near zero-growth mode except for Techs, hamfests need showmanship to attract attendees. Hamfests are in serious need of some new ideas and sizzle.

Adventure Anyone?

Are you getting your share of adventure out of amateur radio?

The greatest adventures of my life have come from ham radio, so in my radio interviews and hamfest talks I point out the adventures the hobby makes possible. Whether you take advantage of the opportunities for adventure or not is up to you. They're there, if you watch for them, and your ham ticket is the key to open the door to adventure.

My ticket got me into the Navy during WWII as an electronic technician. I was originally slated to work in a research lab in Anacostia, Virginia, right across from Washington, DC. Instead, I volunteered for duty on a submarine and as a result had a couple of lifetimes-worth of adventure. I've written about all that in my $8 book on the subject. We had quite a few ver-r-ry tense moments. It sure was exciting at times.

Hey, how come you've never gone on a DXpedition? Ask anybody who's gone on one and they'll tell you that you'll remember every minute of it for the rest of your life. My first DXpedition was to Navassa (KC4AF), a tiny island down between Jamaica and Haiti. Wow, what a fantastic trip that was! Yes, we came tha-a-t close to being killed a couple times...but we weren't.

Then there was the time I heard about an around-the-world flight with a 20m ham station aboard that needed an extra operator. Operation World Wide, it was called. That's right, an all-expenses paid trip around the world, working 20m all the way around! Yes, of course I volunteered.

Or how about the time Robbie 5Z4ERR on 20m talked me into visiting Nairobi? Well, I'd just read a book by Herter on how to go on an African Safari for $690, so I asked for some company in my editorial and got two hams to go along. And since it only cost a little more to keep on going around the world, we went hunting and then got to places like Baghdad, Khartoum, Katmandu, Damascus, Rangoon, and so on, operating wherever possible. Like from the now famous American Embassy in Tehran. And Afghanistan. Talk about adventure!

How about when the State Department selected me to
Continued on page 40

Number 32 on your Feedback card

73 Review

A $60 Red Hot Receiver Kit!

The Ten-Tec 1253—another winner. Fire up your soldering iron!

Mike Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

It's just about as old as radio itself. I'm talking about the regenerative receiver, which was invented by Major Armstrong. This is the receiver that got the radio hobby we have today started. Along with the "super-regenerative" receiver and then the "superhet," radio has changed very little from the rig Armstrong invented so many years ago. I've never had the time to sit down and build a tube type regenerative receiver, but I've read countless articles on their construction. So, when I spied a regenerative receiver kit made by Ten-Tec, I knew I had to have one.

The Ten-Tec 1253 is a nine-band regenerative receiver with more features than most direct conversion (and superhet) rigs many QRPers build. And there's more. For, you see, Ten-Tec also designed this kit around a really slick-looking box. It's much more radio than you might think, with a selling price of $60. You get a lot of controls to play with. There's RF gain, regeneration, main tuning, fine-tuning and the volume control (see **Photo A**).

"The result is a good looking, good sounding radio for a darned good price."

You can select any of nine popular shortwave bands by the use of pin diodes. The regulated power supply and the varactor tuning produce a smooth tuning action. The use of a "bandspread" fine-tuning control makes picking out CW signals a snap! Best of all, there's not a single coil to wind! So, with that in mind, let's look a bit closer inside the Ten-Tec 1253 shortwave receiver.

Inside the kit

There are two PC boards. One contains the audio, regeneration components and the required L/C networks for the various bands. The second board contains the band switching electronics. This small board is double-sided with plated-through holes. The main PC board is single-sided and not plated. However, there is a coating on the main PC board that acts as a solder mask. Although this coating covers every pad on the board, you can solder through it with no problems (see **Photo B**).

All the pieces parts are included for both PC boards. Ten-Tec gives you all the nuts, washers, and board-mounted components.

Assembly is straight forward. The manual starts out with several questions and answers about following the manual or jumping right into the pile of parts. I decided to follow the manual, beginning the assembly by stuffing the main PC board with the audio components. After soldering and cutting off the wire leads I had the option of testing out this part of the receiver before proceeding. I recommend you follow Ten-Tec's testing steps. After all, if the audio section doesn't work, adding more parts to the circuit board will not fix the problem in the audio stage.

I tested the audio and found it working as it should. I also noticed, as the assembly instructions continued, a note about wrapping the loose wires (used in the audio test procedure) around the volume control to prevent their breaking off. That's a nice touch.

The next step was to follow the step-by-step instructions for assembling the RF amplifier, the regenerative detector, and varactor tuning.

Again, they suggest you test the receiver to make sure the regenerative detector is working, before going to the next step, which is to decide how you want the regenerative detector to work. Adding an extra coil and capacitor to the detector controls changes how the regenerative detector behaves. Adding the extra parts increases the sensitivity to weak signals, but requires a careful hand in controlling the regeneration control. Ten-Tec recommends that newcomers to regenerative receivers *not* install the two extra parts.

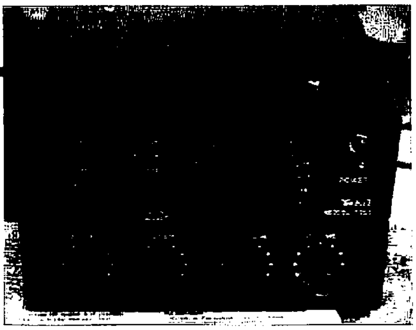

Photo A. You get a lot of controls to play with. There's RF gain, regeneration, main tuning, fine tuning and the volume control.

The next testing step has you adding the necessary parts for one band. The band selected is 6.8 to 8.5 MHz. There's always something on these frequencies, no matter what time of day or night.

I noticed two things when I applied power to the radio. First, the damn thing worked! Second, the radio sounded *really* good! There's plenty of audio from this little guy, thanks in part to the hybrid audio amplifier. With the radio operating, I tackled the band switching board, which was a bit tricky to assemble. Parts are placed on *both* sides of the board, so it's easy to get confused as to what goes where. Ten-Tec makes the assembly as painless as possible with an oversized PC board layout and a table showing you on which side each part goes.

The hardest part is aligning the nine small LEDs with the holes in the front panel, and then soldering them in place.

The mounting holes on the front panel are designed to allow some slop in your assembly of the LEDs.

After you have checked out the band switching board, you finish by stuffing the balance of the band specific components on the main PC board. This requires close attention. If you get one of the inductors or one of the wires from the band switch out of place, then the selected band may not match the LED.

The only steps left were connecting the remaining wires to the two circuit boards and installing the hardware. The receiver is assembled on a sub-chassis and then the sub-chassis is mounted inside the main box. There are two plastic battery holders to hold the eight C cells for portable use which mount above and to the rear of the sub-chassis, using a second sub-chassis.

All in all, Ten-Tec did a marvelous job of designing the 1253 kit. But naturally, like any ham, I have a suggestion: How about putting the main PC board overlay on a separate sheet of paper along with the schematic of the 1253? That would make it easier to troubleshoot without having to flip back and forth between the pages of the manual.

The manual

Aside from the single overlay sheet, a complaint I have with nearly all kits, the manual is complete and easy to understand. Ten-Tec has included points of soldering, installing parts on the PC board and detailed operating instructions. There's even a section on installing an antenna and how to tune in SSB and CW.

On the air with the Ten-Tec 1253

The 1253 takes some getting used to. When you advance the regeneration control to just below the point of oscillation, this is the best place for AM detection. Then you advance the regeneration control a hair to where the detector breaks into oscillation for CW and SSB reception. By selecting the point of regeneration, you have control of how sensitive the detector is.

It's amazing how sensitive the 1253 is! I was able to pull in AM shortwave stations from all over the world with just a 10-foot length of wire lying on the floor.

The ability to operate from the internal batteries makes the 1253 an ideal travel companion. And there's plenty of room inside to install a simple RF preamplifier. Drill a hole in the top for a telescopic antenna and you'll have a fine rig for camping. A rear-mounted headphone jack automatically disconnects the internal speaker.

In use you'll find that with a regenerative receiver strong signals have a tendency to swamp the detector, causing it to lock up on the signal. And increasing the RF gain causes it to change frequency. Although the 1253 has a stage of RF amplification, regenerative receivers do produce a signal (the output of the detector) that can radiate quite some distance.

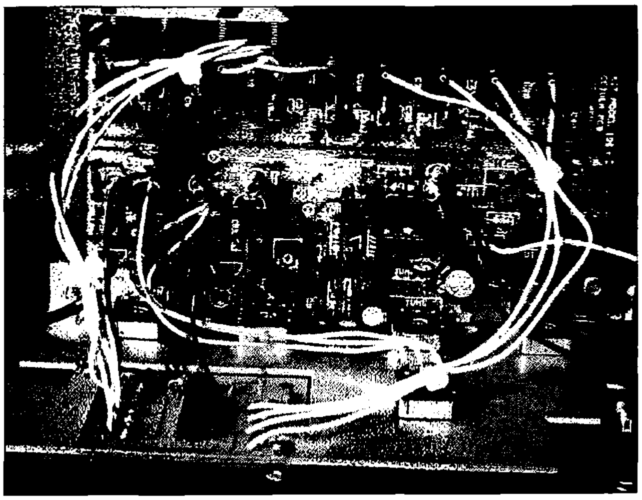

Photo B There are two PC boards. One contains the audio, regeneration components and the required L/C networks for the various bands. The second PC board contains the band switching electronics.

All in all, I had a ball with this guy. It's easy to build and easy to fix. The end result is a good looking, good sounding radio for a darned good price. I highly recommend the Ten-Tec 1253 shortwave receiver kit. Interested? Call Ten-Tec's information line at (423) 453-7172, or write them at 1185 Dolly Parton Parkway, Sevierville TN 37862-3710.

Simple Crystal Activity Tester

Check and match crystals for your home-brew projects.

J. Frank Brumbaugh KB4ZGC
P.O. Box 30 - c/o Defendini
Salinas PR 00751-0030

Quartz crystals are found in practically every piece of electronics used by today's amateurs. Hams who build their own equipment find themselves using crystals in many projects.

Many low power transmitters and double conversion receivers require crystals for their stable oscillators. Crystal ladder filters used in receiver IF circuits must have crystals closely matched in frequency to ensure steep skirts.

Crystals are available from a variety of sources. Most hams, especially older hams, usually have spare crystals in their junk boxes. These are often available for very low prices at hamfest flea markets. Most such crystals are in the lower ham bands, while some are multiplier types for higher frequency bands.

Most mail order parts dealers advertise long lists of inexpensive surplus microprocessor crystals, ideal for ladder filters in receiver IF strips. Many, too, are suitable for use in home-brew test equipment such as capacity and inductance measuring instruments.

Regardless of its intended use, a crystal must be active. That is, it must start oscillating immediately when power is applied. It must oscillate on a single frequency, and that frequency must be stable. The more active a crystal is, the better it will perform, whether as an oscillator or in a filter.

In addition to being of good quality, the several crystals used in receiver IF filters must all be matched to the same frequency within tight tolerances. Purchasing a set of four, six, or more frequency-matched crystals from a manufacturer is extremely expensive. Buying a handful of surplus microprocessor crystals for about a dollar each and matching them yourself will cost only a fraction of the price of a commercial set.

The simple instrument described here enables easy checking of crystal activity. Used with a frequency counter, crystals can readily be matched in frequency to within a few hertz. It covers the important range of below 1 MHz to slightly above 13 MHz. The crystals used by hams in oscillators and filters fall within this range of frequencies.

Two versions of this instrument are illustrated: a simple and a deluxe. The only difference is in the method of indicating crystal activity. In the simple version, the brightness of an LED indicates activity level; in the deluxe version, a meter indicates activity level. In its simple version this instrument can be constructed in under one hour for less than five dollars, and probably at no cost at all when using junk box parts. The deluxe version will cost little more.

Circuit description

Fig. 1 shows the schematic version for the simple version; **Fig. 2** illustrates the changes required for the deluxe version. Please refer to this illustration for the following discussion.

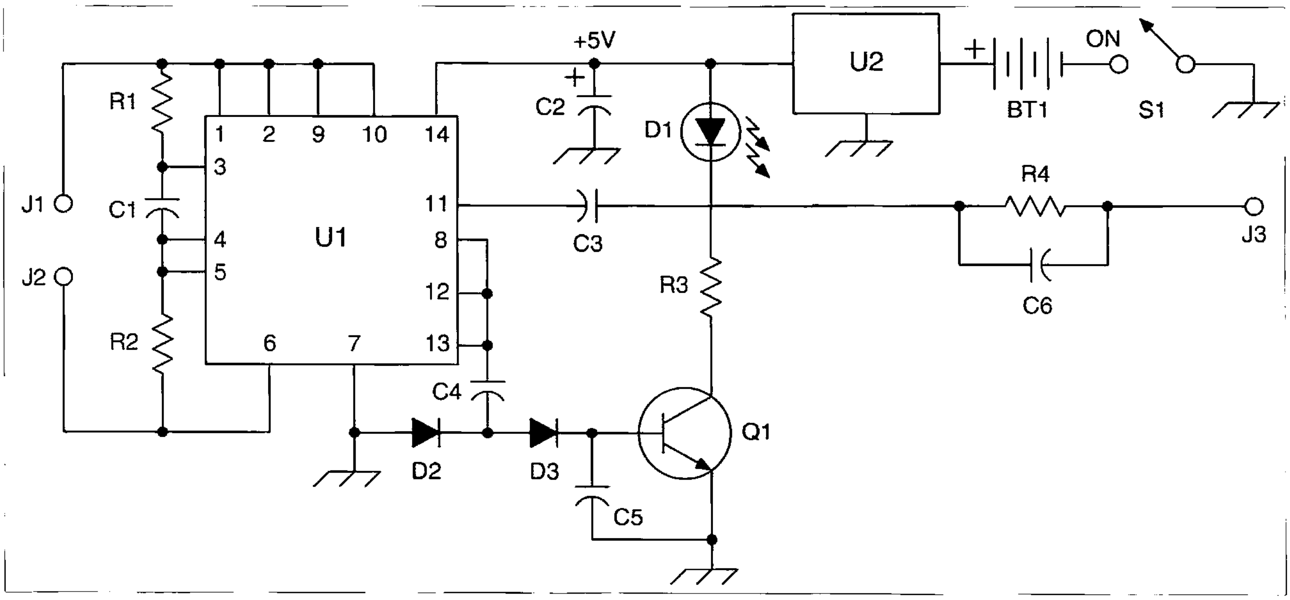

Fig. 1. Crystal matching and activity tester: simple version.

Power is supplied by a 9 volt alkaline battery (BT1) and is controlled by ON/OFF switch S1. Nine volts is applied to the input of U2, a 78L05 three-terminal regulator which produces a regulated +5 VDC for the circuit. The positive bus is bypassed by C2, a 10 μF electrolytic capacitor.

U2 is a 74LS00 Quad two-input NAND gate logic chip. The LS version was selected because of its low current requirement. Two of its internal gates are connected as inverters and, in conjunction with R1, R2, and C1, form a crystal oscillator when a crystal is connected between J1 and J2.

The third gate, also connected as an inverter, is used as a buffer to provide RF at the crystal frequency from pin 11, through isolation capacitor C3 and high-pass filter R4 and C6, to J3 so the crystal frequency can be monitored by an external frequency counter.

The fourth gate, also connected as an inverter-buffer, provides RF at the crystal frequency from pins 8, 12, and 13 connected in parallel. The RF is fed through isolation capacitor C4 to voltage doubling rectifiers D2 and D3, and the resulting DC voltage is filtered by C5 and, in the simple version, provides a positive bias to the base of Q1, an NPN transistor, which is normally cut off. Q1 goes into conduction and its collector current flows through LED diode D1 and R3 in series, both forming the collector load circuit. The greater the activity of the crystal, the higher the positive bias on the base of Q1 will be, and the higher its collector current will be. This current illuminates D1 and its relative brightness is indicative of the level of crystal activity.

In the deluxe version, the filtered DC voltage across C5 is applied to the positive terminal of M1, a 0-1 mA meter, whose negative terminal is connected to the wiper of R5 (a *sensitivity* potentiometer), one end of which is grounded. R5 is used to keep the needle of M1 on scale, and M1 indicates crystal activity level. Using this version makes it easy to match crystals of the same activity, or to select the one having the highest activity. The meter won't give an absolute value reading, but it can be effectively used for relative comparisons between crystals.

Construction

This tester can be constructed on a small piece of perf board, or on one of the small general purpose printed circuit boards available at Radio Shack™. It can also be built "dead-bug" style by gluing U1 and U2 upside down on a piece of wood or plastic. No enclosure is absolutely required, but if you expect to use this instrument a number of times it should be enclosed in an aluminum or plastic box, or in a case made of printed circuit board material. This is especially desirable if the deluxe version is constructed because the enclosure will provide a secure mounting for the meter.

J1 and J2 are specified as binding posts because most surplus microprocessor crystals are available in HC-18U or HC-33U cases with wire leads. Most other crystal case styles require sockets. Crystal sockets can be wired in parallel with J1 and J2 for greater convenience in testing various types of crystals.

The leads between U1 and J1/J2, plus any parallel connected crystal sockets, should be kept as short as possible.

The circuit between pin 11 of U1 and J3 should also be as direct as possible and its wiring kept away from the walls of the enclosure, if one is used.

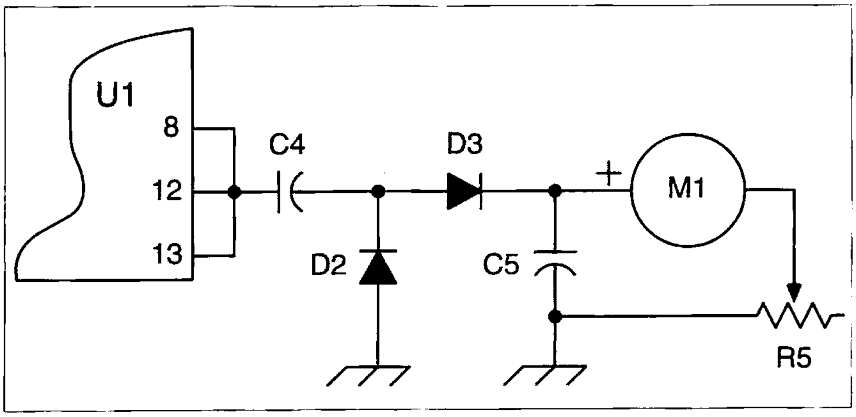

Fig. 2. Crystal matching and activity tester; changes for the deluxe version.

C4, C5, D2 and D3 should be physically close to U1. All other wiring carries only DC voltages and can be any reasonable length.

Operation

Operation is automatic. Set S1 to ON and connect a crystal with a frequency between 1 and 13 MHz between J1 and J2 or in a parallel socket. Observe the relative brightness of D1 in the simple version, or the indication on meter M1 in the deluxe version. Use the sensitivity control R5 to keep the M1 needle on the meter scale.

To measure the series resonant frequency of the crystal under test, connect the input of a frequency counter between J3 and ground and observe the frequency on the counter's readout.

Comments

This instrument is designed to function with crystals whose fundamental frequencies lie between 1 and 13 MHz. Some crystals slightly outside this range may oscillate, but this cannot be guaranteed.

A crystal which shows no, or very low, activity is either bad, suspect, or outside the range of this tester. Even if a crystal is marked with only a house number, instead of its frequency, it should be tested. It may very well be a useful crystal for you.

A sluggish crystal, one whose output level varies or which will not oscillate every time it is connected to this instrument, should be discarded unless it is in an FT-243 crystal holder. This special case will be discussed later.

Most crystals manufactured recently are sealed in metal cans. Normally these crystals are quite active and stable, although all crystals age, causing them to oscillate at a slightly different frequency than when first manufactured. If a crystal (within the range of this tester) in a sealed metal can refuses to oscillate, discard it. Perhaps the quartz blank is contaminated, or cracked, or one of the fine wires soldered to the metallized surface of the crystal has been detached. Rough handling, including simply dropping them on a hard surface, can destroy these crystals.

Restoring FT-243 crystals

Crystals in FT-243 holders, most of which are WWII surplus, often are available very cheaply at hamfest flea markets. Most are in the lower ham bands, or have frequencies suitable for multiplication to higher bands. Many of these crystals may either refuse to oscillate at all, or may be sluggish or have low activity, but many are easily salvaged unless there is internal mechanical damage.

You will need a brightly lighted work space, a clean, soft cloth to cover it, a pair of tweezers, a small Phillips-head screwdriver size 00 or 000, some alcohol (rubbing alcohol and vodka are suitable), and cotton swabs.

Spread the clean cloth over your work space. Using the small screwdriver, carefully remove the three tiny screws holding the metal faceplate to the plastic crystal holder.

Caution: Hold the metal faceplate firmly to the case while removing the screws. Do not allow the internal spring to toss the faceplate and crystal blank across the room!

Gently dislodge the faceplate and the rubber gasket behind it, and remove the spring. Set them aside for now.

The quartz blank, about half an inch square, rests between two very delicate thin brass plates. One lower corner of each brass plate is soldered to the holder pins. Gently shake the quartz blank from the holder onto your cloth work surface and set the holder aside.

Caution: Use extreme care not to break the connections between the brass plates and the pins. It is impossible to repair the holder in this case.

Very carefully, using a swab or the corner of a clean, soft cloth dipped in alcohol, clean the insides of both thin brass plates in the holder. Gently blow out or scrape out any loose dirt inside the holder. Set the holder aside to air dry.

Clean the crystal blank with alcohol as just described, using tweezers to hold it and move it around. *Never* touch the quartz blank with your fingers, and try not to breathe on it. When it is clean, set the blank aside to air dry.

Now clean the outside of the crystal holder, rubber gasket, and metal faceplate with alcohol, and set aside to air dry. Fold the clean cloth over all the pieces to keep them dust free. Be sure to allow plenty of time for the alcohol to evaporate.

When all is ready, pick up the crystal blank with tweezers and insert it into the holder between the two brass plates. Gently replace the spring on the outer brass plate, centering it. Then replace the metal faceplate and rubber gasket, gently forcing them against the spring until the three screw holes in the faceplate line up with matching holes in the plastic holder. Replace the three tiny screws, snugging them up firmly. Do not use so much pressure that you strip the threads in the plastic holder.

Clean off the outer surface and pins of the holder, then connect it between J1 and J2 or insert it in its socket. Turn the tester on and check for crystal activity and frequency. Chances are you will have salvaged a tired crystal and given it new life.

Parts List

BT1	9V alkaline battery
C1, C3, C4, C5	0.01 μF ceramic disc
C2	10 μF 16V electrolytic
C6	27pF ceramic disc
D1*	LED
D2, D3	Silicon diode: 1N914, 1N4148, etc.
J1, J2, J3	Binding post (see text)
Q1*	NPN 2N3904, 2N2222, etc.
R1, R2	560 ohm 1/4W 5%
R3*	300 ohm 1/4W 5%
R4	1.2 megohm 1/4W 5%
R5**	Øk ohm potentiometer
S1	SPST toggle or slide switch
M1**	Ø-1 mA meter
U1	74LSØØ
U2	78LØ5

*Used on simple version only.
**Used on deluxe version only.

About Surplus Crystals

Crystals can be, and are, ground to various tolerances, expressed in ppm (parts per million; hertz per megahertz). Close tolerance crystals can be very expensive. Most crystals on the surplus market have relatively wide tolerances. Microprocessor crystals, such as those sold surplus by many mail order parts dealers, are usually ground to a tolerance of ± 500 ppm—a half kilohertz per megahertz. A crystal marked "10.000000" can actually be anywhere between 9.995 and 10.005 MHz. The chances are very good that surplus crystals are mostly those whose frequencies fall outside even that wide tolerance. However, when used in transmitters, local oscillators, product detectors and BFOs, it is relatively simple to adjust the crystal to the exact frequency required. Most oscillator circuits contain trimmer capacitors that allow the exact oscillator frequency to be varied a small amount on either side of the crystal's resonant frequency. This process—called rubbering, warping, or trimming—allows precise adjustment of off-frequency crystals.

Crystals intended for use in an IF crystal ladder filter must be matched closely to each other in frequency to maintain steep skirts, although the exact frequency is relatively unimportant. So an 8 MHz crystal filter *might* have all 8.000000 MHz crystals in it, but it is far more likely that all crystals are somewhat below or above 8 MHz. But this filter still functions exactly as it was intended.

Microprocessor crystals, although marked with their *nominal* frequency to six decimal places, are manufactured specifically for use in either their series or parallel mode of oscillation. It is impossible to know which when you buy such a crystal. It also makes absolutely no difference because you are going to use it in an entirely different circuit than that for which it was ground.

There is always a slight difference in oscillation frequencies between a crystal operating in its series mode and the same crystal oscillating in its parallel mode. Regardless of the manufacturer's intent, you can use the crystal in either type of circuit, or in a filter.

Depending upon the circumstances, some circuits used by hams force the crystal to oscillate in its series mode, while other circuits force parallel mode oscillation. This instrument allows crystals to oscillate only in their series mode, at the fundamental frequency to which the quartz blank was ground. It is far simpler and cheaper to build an instrument to check crystal activity and frequency in the series, rather than in the parallel mode. Crystals used in the series mode, such as in IF filters and certain types of crystal oscillators, will be resonant at the exact frequencies measured by this instrument. When a crystal is used in a circuit where it oscillates in its parallel mode, it will produce a very slightly different frequency than that measured in its series mode. Usually, this will make no difference. Where it may be important, the crystal frequency can be easily trimmed to an exact frequency.

PVC Goes Camping

Full-time RVers, take note!

James Bassett KA1FPP/7
7420 Silver Leaf Way
Las Vegas NV 89117

Now that summer has arrived, it's time to get out the camping equipment. My list starts with: QRP rig, CW key, mike, coax, some wire, slinky...Did he say slinky? Did he mean the Slinky™ kids play with?

Yep, sure did. Seems the Slinky vertical fits into the camping box better than the 25-foot trap vertical or the poles needed to hold up a dipole. The Slinky is cost-effective; last time I bought one it was under $2.

Why a Slinky?

I camp quite often at the Lake Mead National Recreation Area. The total number of trees is zero, meaning that any antenna must be self-supporting. The soil in the area varies from soft silt to hard as cement, making it necessary to devise a method that will not require that the ground conductivity be a factor. The structure supporting the Slinky must be flexible, lightweight, strong, and easy for one person to manage. With these requirements in mind, I designed the Slinky Vertical. A standard Slinky serves as the main radiating element, and common PVC tubing provides the support structure. The resulting antenna is quickly assembled, easily moved, and can be stored in a very small space.

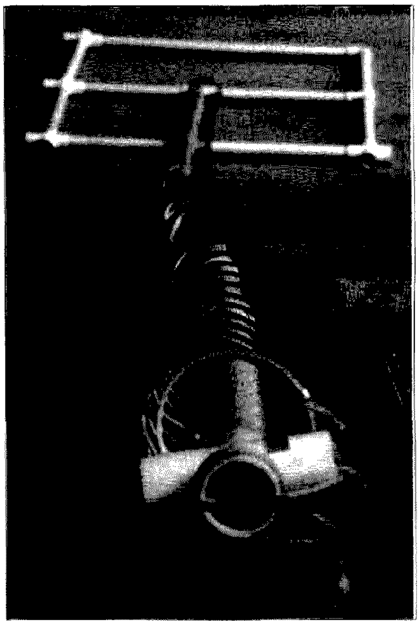

Photo A. The top guy ropes are tied to the upper PVC cross before the antenna is erected.

Construction

The PVC is cut into sections that fit into the bottom of my camping gear box. This makes it easy to store and carry. Other PVC pieces required include: double females, tees, and crosses. Precutting several pieces at home to form the base saves time later at the campsite. My version used a square base, but feel free to modify the dimensions to fit your particular application. This system is assembled on the ground and set upright when completed. A T-shaped PVC piece is required in the center of the base to control the bottom of the vertical support. Two of the vertical support pieces must have 1/4-inch holes drilled through one or two inches from the end. Two 6-inch by 1/4-inch dowels inserted through the holes will secure the Slinky to either end of the PVC mast. The remaining sections with associated female connectors are assembled to make the vertical support. The PVC pieces with 1/4-inch holes in them are placed at the top and bottom of the vertical support assembly.

Insert a dowel into the lower section of the support; it can be held in place by a rubber band. Place the Slinky over the support, hooking a couple of coils over the dowel. Put the other dowel in the upper support, then stretch the Slinky along the full length of the PVC assembly, hooking a couple of coils over the upper dowel. Again, a rubber band can be used to hold the dowel in place. Place a PVC cross-shaped piece on the top. Attach lightweight guy lines to this tie point. (*Caution: Depending on how tall you have made the support, you may need guys in the middle to keep it from bending.* A PVC cross may be placed in the middle of the vertical support as a tie point. Experiment at home before going camping.)

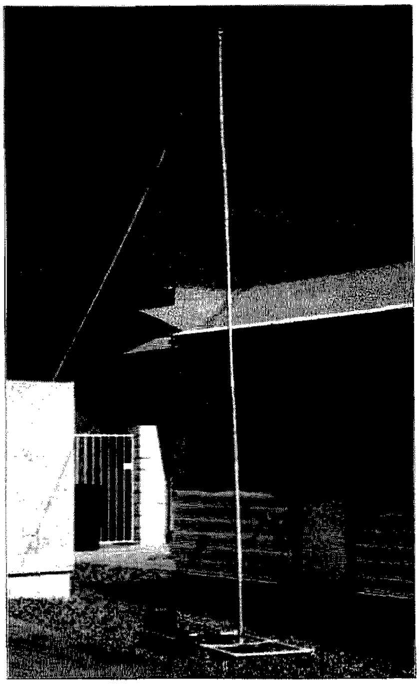

Photo B. Entire station set up at home, prior to going camping.

Now the tricky part: Tie off two guys loosely with enough slack to allow the antenna to be placed upright. Stand the structure up and tie off the third guy. Now go to each guy and adjust accordingly. The antenna shown in the photos is 13 feet tall and works well with just top guys.

The Slinky will stretch taller; in that case you will need to guy the structure in the center. I've used it to 18 feet with two sets of guys. The length of the Slinky if it's stretched out is approxi-

mately 67.5 feet of radiator, close enough for a quarter wave on 80 meters. This configuration is a high Q design. To lower the Q and increase the bandwidth, add a capacitance hat. You can use a short vertical rod or a round piece of metal for the hat. The vertical rod is the easiest to use. Simply tape it to the PVC and use a jumper from the Slinky to the rod. If you plan on running high power, the hat is required.

If you camp where there is no place to anchor the guys, you'll need to improvise. I've used my spare tire, tools, the camping box partially filled with sand, a garbage bag with sand, or whatever was handy. The entire antenna system only weighs a few pounds but your anchors should be heavy enough to hold it in place if the wind picks up. Use your imagination and have some ham radio fun.

On the air

Well, that took 15 minutes, so let's get on the air. Gator clips were preinstalled on the coax so connect the center lead to the Slinky, the shield clip to the ground wire, and the other end of the ground wire gets thrown into the lake. When the lake isn't available I just make a wide circle around the base of the antenna. Either way, it radiates. You may want to cut radials for each frequency you will operate.

I've found most campgrounds don't have enough room to string out a standard set of radials. In this situation, run coax into the back of the rig. Hook up the rig to the coax, power supply, CW key, and mike. Turn on the power supply and the radio. Now the magic...check the SWR...ouch! Sure is high...unkey the radio, run over to the base of the antenna and move the clip on the center lead up the Slinky...recheck the SWR...ouch!...(still high, but better). Keep up this procedure until the SWR is acceptable.

If you want to save the running back and forth, here are two suggestions: 1) Use a tuner and you are on the air in minutes; or 2) Use one of the antenna analyzers on the market. It will tell you almost instantly how far off frequency the antenna is and makes the adjustments much easier and faster. I've used both methods and prefer the second.

***Photo C.** The left clip is from center lead of coax to Slinky; right clip is shield of coax to radial; 1/4-inch dowel holds Slinky in place.*

Complete campsite station requirements are listed in the sidebar. *Important: Know what kind of connectors you need to make everything work together before you leave home!*

Minimum Requirements for a Successful Ham Camping Trip:

Transceiver
CW keyer
Microphone
Slinky™
Power supply with cables to attach to the radio (match power supply to the transceiver's requirements)
Guy lines (heavy twine works)
Guy line anchors
PVC (approximately 20 feet) with necessary elbows, tees, and crosses
Coax with clips installed on one end and proper connector on the other to fit the radio
Scratch paper
Log
Pencil
Ground wire/radials
Spare fuses

Optional:
Tuner
Antenna analyzer
Headphones
Speaker
Tape
Metal plate or rod

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represent amateur radio at the WARC conference at the ITU in Geneva?

Adventures like this are there if you keep your eyes open. And ears. Even ham visits to the Caribbean can be a ball. It doesn't cost much to get on the air from any of the islands down there. And the local hams are wonderfully friendly. But then you haven't bothered to send for my *Caribbean Adventure* book yet. Tsk. How about an inexpensive bed and breakfast on Montserrat, complete with an operating ham station and swimming pool?

Or the time I heard that King Hussein JY1 had gotten on the air. Most hams did nothing. I cabled him and asked if he needed some help with the pileups. A few days later I was on my way to Jordan and an incredible adventure.

So what's your excuse? Is it a lack of initiative? Laziness? No motivation? No determination? No guts? None of my adventures would have happened if I hadn't taken some initiative. I find you can do almost anything if you decide to and then stick to it. That's how I took off nearly a hundred pounds of lard which I'd been lugging around for many years. And I've kept it off.

But, you know, I get discouraged. When I preach adventure you head for the couch and a ball game with a six-pack in hand, or for a rag-chew about nothing on 75m. I try to explain how you and your family can live a long, healthy life and you get mad because I'm not writing only about ham radio. Sigh.

Maybe there is no way to motivate the grossly fat hams I see at hamfests to add years to their lives, or to get the average ham to even consider volunteering for an adventure.

I remember the time I organized a ham tour of Europe. 73 of us visited London, Paris, Geneva, Rome and Berlin, and we had a fantastic time. We had ham parties in every city except Rome, but we did have an audience with the Pope there. And we pulled off the whole tour for $550 a person, and that included nice hotels, great parties, and all flights. That was the normal round-trip tourist fare to Rome at the time, to give you some perspective on how inexpensive it was.

You won't believe how cheap you can travel unless you start reading my two $8 travel books.

I wanted to put on another European tour, but the ARRL had proposed what they called "Incentive Licensing" to the FCC and the whole ham industry was being destroyed. It was really tough on my upstart magazine when 85% of the ham radio stores carrying it went broke and over 90% of the manufacturers went out of business. Hams by the thousands, in a panic over the proposed legislation, sold off their stations for anything they could get for them, all in a couple of years. The hobby has never really recovered.

But even with the hobby in deep trouble I was having fun and adventure. I found a house for sale high up on the highest mountain in southern New Hampshire, just a few miles from my home. There I set up the darndest VHF ham station, with four big towers and huge antennas. On 2m I had 336 elements, fed by a kilowatt, and two kilowatts of audio for the AM signal. Talk about punch! My signal over the whole east coast was legendary. I worked walkies down in New Jersey, 250 miles away! Expensive? Of course not. I swapped advertising for the ham gear and towers, and had the help of $20 a week plus room and board college drop-out hams in setting up and operating it. We were all living and working in my 40-room house, with me cooking all the meals.

Now, let's talk about what adventures you've had so far. Adventure is right there, waiting for you.

Pioneering new communication modes is an adventure too. As soon as I heard about Jack Babkes W2GDG inventing narrowband FM, I modified a BC-459 exciter and was giving it a workout on the air. Now NBFM is mostly what we use on 2m and up.

I built an SSB rig and got on the air with 5 watts and a dipole antenna on 20m. My first contact was with Australia! And so it went with RTTY, slow-scan, and repeaters. I was the first ham on 6m in New York City. I helped W2BFD put up the first repeater in the east so all the RTTY gang could communicate. If you don't think putting up a repeater antenna on top of a New York skyscraper in a snowstorm in the middle of the night is an adventure, then take a look at the Municipal Building roof some time. It's copper-clad and has a 30° slant. I had to hold onto the little pegs fastening down the copper plates to keep from being blown off the roof. How about working seven states on 10 GHz with a tenth-watt little box for adventure? Or talking to hams all around the world via moonbounce using the thousand-foot dish at Arecibo?

Good grief, are you still just sitting there? There isn't one thing I've done that others couldn't. It's just a matter of initiative.

More Surplus Coming?

The FCC is considering "refarming" the frequencies below 512 MHz. By that they mean narrowing the bandwidths permitted. While the commercial companies providing the communications services will benefit by being able to service twice as many users, you can bet that the users of those channels will be fighting the move since it'll mean a massive obsoleting of their equipment. Users will have to get new rigs to meet the new restrictions.

It was just such a move about 35 years ago that obsoleted tens of thousands of taxicab radios and their communications systems, when they went from 30 kHz wideband FM to 15 kHz. It was this massive changeover that sparked the amateur radio 2m FM and repeater revolution. The first repeaters were on 30 kHz channels, starting at 146.64 MHz and going on up to 146.70 (which was an RTTY channel early in the game), 146.76, 146.82, 146.88, and 146.94. The 60 kHz separation allowed for the 30 kHz bandwidth of the users without too much interference from the adjacent channels.

It wasn't long before we had to go to narrowband FM, as pioneered by W2GDG back in 1946. He later formed Sonar Radio to market the mode and made millions. That allowed twice as many channels. And when those filled up we started using the 147-148 MHz segment too. Eventually that filled up, so we narrowed down our receivers even more, doubling the number of channels again. I won't get into a discussion on how much we're using all of those channels. I suspect that the goal for most hams is to have one channel for every ham for his repeater, and never mind that there is no one left to use it but him.

If the FCC is successful in forcing the commercial users below 512 MHz to buy new equipment, we're going to have a ball with all that cheap surplus mobile equipment. It's also going to be a bonanza for the equipment manufacturers, generating billions of dollars in sales. Of course this is going to tend to raise our state and federal taxes, because our blessed government is a big user of these frequencies.

The downside is that with all this great, cheap equipment, we may not have any frequencies left we can use it on. But that's pretty much up to you and whether you and your club are interested enough to put up a fight.

The Internet

I recently pointed out that the Internet is posing more and more competition to ham radio. Now you can chat with people almost anywhere in the world without any worry about QRM and propagation. And cellular telephones have taken away most of the need for our ham repeaters for emergencies, making them largely an improved CB type communications system for Techs.

Maybe what we need now is a special section on the Internet just for hams. We should set it up so it will provide the ability to make a contact with people around the world only when 20m propagation would normally permit it. We'd have a computer generate crosstalk, fading, and other normal interference, to provide realism. Contacts would be limited to one minute, tops. Of course we'd have simulated pileups on the rarer countries.

For further realism, we'd charge 10¢ a minute for a simulated 10-watt signal, 20¢ a minute for a 100-watt signal, and 40¢ a minute for a kilowatt signal. A California Kilowatt signal would cost a buck a minute, and be well worth it! How about 1-watt signals being free? Sure, why not?

This contest, like DXCC, could run 24 hours a day, 365 days a year. Hmm, if we figure that this would be restricted to 25 kHz of the 20m band, that would mean about five channels. This would take five channels on the Internet. No problem.

When I spent some time working DX from Afghanistan as YA1NSD I noticed that the Big Signal US hams were in there solid every night. The plain old kilowatts with triband beams came through about four

nights a week. The 100-watters maybe one night a week. The 10-watters maybe one night a month. That wouldn't be difficult to program into a computer.

All you'd need is the bucks and the time, and you'd have your 400 countries worked, just like on amateur radio. Once I got a kilowatt and a good beam working up here in New Hampshire I worked 100 countries in a week, 200 in a month, and 300 in less than a year. But then I had to take some time away from operating to put out *73*. With so many hams retired, many should be able to easily beat my record. I did once work 100 countries in a weekend on 20m phone, but that was during a contest. I just wanted to see if I could do it.

With the FCC under pressure from Congress to sell off as much of the spectrum as possible, and with us having more spectrum allocated than any other service, we'd better start making plans for meeting the communications challenges of the 21st century. But without counting a whole lot on using radios. Maybe we can at least keep the spirit of amateur radio alive via the Internet. Will Dayton have to hold yearly InterVentions?

Is CW Dead?

Somehow I've managed, in some minds (?), to come across as a CW-basher. Piffle. I'm a basher of the use of the code as the major barrier to keep new hams away from the HF bands. As I've mentioned, probably too many times, it was my code skill that saved me and my submarine during WWII. I have always championed the use of CW as a fun mode for hamming. It's great for DX contacts where English is a barrier. And, for those who are proficient, it's a great way to communicate.

If the code hadn't been mandated by the government I probably would have enjoyed it. But I have a serious, probably genetic problem. When someone forces me to do something that doesn't make any sense to me, I resent the hell out of it, and I resist. I've checked a couple of my past lives and, sure enough, I was a troublemaker there too. I had problems with my folks when I was young. "Because we told you to," wasn't enough of an answer when I asked why I should do something, even when it meant a spanking.

The Navy and I had some problems with this. They operate on this weird slave-type system of they tell you to do something and you do it. It took me a while to adjust the Navy to my thinking. Well, I didn't have much success with the whole Navy, just with those around me. Ask me and I'll do almost anything. Tell me, and you can go to hell.

Anyway, let's stop this stupid idea that I'm a CW basher. I do think it's a good idea for survival trainees to know the code, just in case. It sure helped Scott O'Grady get out of Serb-held Bosnia when his plane was shot down. But then he had to use voice to confirm his identity. You don't need to be a 35 wpm speed king for that, you just have to have memorized the Morse alphabet. And that only takes a few minutes put of a whole lifetime.

I do wish that there were more people who would demand reasons for doing things and not just meekly follow along, head down, sheep-like, doing whatever someone else tells them to. That's all it would take to clean up the lousy government we've allowed to build up. Can you point to one major social problem in America that hasn't been caused by the government you elected? And continue to re-elect? One? Hmm, let's see, what time is Roseanne on tonight? And The Simpsons?

Pioneering Opportunity

An item in a recent *Fortune* on how to cut your phone bill by 96% attracted Wily Wayne's attention. I'm not cheap, I'm just thrifty (Never Squander Dollars). So I looked into it. What VocalTec has is a software package ($59) which allows computers to send voice over the Internet to anyone else using the same software. It uses data compacting and allows one-way ham-type communicating anywhere in the world via the net. For $1 to $2 an hour vs. about a buck a minute to talk with someone in Hong Kong!

Instead of brooding over this latest Internet assault into ham territory, I said to myself, hey, how about using this cutie to narrow the bandwidth of our voice transmissions? If I don't start hearing the sound of this strange new data swapping on 20m soon, followed by some enthusiastic articles submitted to *73*, I'm going to put you down as being lazy, brain-dead, good-for-nothing, soap opera watching, beer swilling couch potatoes.

The system is set up to use a 486 PC with at least 8MB of RAM, Windows 3.1, WinSock 1.1 14.4kb modem, and a Windows-compatible sound card, microphone, and speakers. VocalTec is at 157 Veterans Drive, Northvale NJ 07467. 201-768-9400, Fax: 201-768-8893. E-mail: info@vocaltec.com. Okay, VocalTec, where's the Mac version? Drat!

Curt LeMay

I had a chance to talk with General LeMay, the head of the Strategic Air Command (SAC), one time at a Sideband Dinner in New York. Curt was blunt. And salty. Curt explained the facts of life to me, and they're worth repeating now. He explained that amateur radio existed as a "service" (read: hobby) for one reason and one f— reason only: The military wanted it. There were two reasons for our military support. Number one, the military wanted to have a bunch of frequencies available they could take over in time of war that weren't cluttered up with the much more difficult to move commercial and broadcasting services. Number two, in case of war they would need men with technical know-how to install, operate, and service electronic equipment.

He was right. At least he was right during the 1930s to 1960s. As I've mentioned, when WWII broke out 80% of the licensed hams

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joined the military, giving our country a tremendous technical edge over Japan and Germany. And it was our electronic technology that won that war. I was there in the front lines, so I know personally what a difference it made. We also donated our ham receivers to help the government. My SX-24 went to war in Brazil with the OSS' Rubber Development Corporation. And I went on a submarine, where I helped sink a lot of Japanese ships.

Today we hams have almost nothing to offer the military. Future wars will be high-tech, but they'll be short. It took us almost two years after WWII started before we really got going with effective radar and sonar. Heck, when I reported aboard the Drum in 1943 we were still using a TRF receiver for low band reception! That design was close to 20 years old by then.

The military has no further need for our ham bands in emergencies. Our ham equipment would be useless for them too. And I'll bet not one ham in a thousand could service the latest military electronic systems. Sure, we could field several hundred Morse Code experts if an enemy bombed us back to the stone age.

They had quite an article on LeMay in the *New Yorker*. It wasn't flattering, so I was just as happy that they didn't mention his being a ham operator (W6EZV), or his part in the promotion of SSB. According to the article LeMay was ready, with or without presidential authorization, to nuke Russia in a preemptive strike. I've written in my past editorials about how Art Collins WØCXX of Collins Radio, with the help of Don Merton K2AAA/W2UOL, got the Air Force to make SSB their standard for voice communications, beating out GE and John Costas K2EN with his technically superior double-sideband system.

Help!

Hey, some of you retired old timers, when it's too wet to play golf or the football game has been canceled on TV, if you have some art skills, maybe you could give me a hand in your spare time. I'd like to use more drawings, cartoons, and other ham-oriented artwork in *73*. I could even use some help in doing schematics, if you've got a good software program for that. Bandel Linn K8LAP did my cartoons for years, but he smoked, so he died in a nursing home. I met Bandel in 1950, when I was working at WASP in Sarasota (FL), where he did a talk show interviewing famous people living in the area. For instance, I got to know author McKinley Cantor through Bandel.

The two of them had a great friendship, with one always trying to outdo the other on practical jokes. Like the time Cantor bought a whole bunch of used books for a quarter each. He stamped Bandel's name and address in them, offering a reward for their return. He then left them all around the country in hotel rooms and stores where he was autographing copies of his books.

Let me know if you've managed to develop some art skills, or at least can handle computer-generated schematics for me. I want to make *73* more fun to read. Yes, of course I'll pay for the work. But not a whole lot. Remember that NSD stands for Never Squander a Dollar.

Antenna Gestalt

How would you, once and for all, like to actually understand how and why antennas work? The basic theory isn't complicated, once you go for the concept instead of being buried in operational details.

For instance, why do beam antennas have gain? Well, that's simple. We have to have a reference antenna to compare to a beam, so we use a dipole, which is a piece of wire cut to one-half wavelength long at some designed frequency. Now, if we're radiating 100 watts from an antenna, that 100 watts is going out in all directions. If we could have an antenna that acted like a point source, our 100 watts would be spread out evenly in a sphere.

So, if we put a mirror under the point source, reflecting back all of the energy normally going down, we'd have our 100 watts being distributed through just half of a sphere, so we'd have twice as much energy at any one point on the half-sphere. Thus, the more we can focus the energy from the antenna in one direction, horizontally or vertically, the more gain we're going to have in a desired direction.

For most of our antennas the earth (aka ground) acts as a mirror. It's a murky mirror, sopping up some of the energy instead of reflecting it all. So we often try to help Big Mutha do her reflecting work with a ground plane or, on the lower bands, a bunch of ground wires under the antenna. The less energy we spend heating the earth and reflecting back into space, the more energy we'll have available to get a signal out. And in, too. Antennas are reciprocal devices, which means they work just the same on sucking in energy as transmitting it.

On the lower bands we have a series of ionized layers of air a few miles up in the (surprise!) ionosphere. These are ionized by being zapped by energy coming from the sun, so the more sunspots Old Sol has, the more stuff that erupts from its surface in solar flares, and the more the earth gets bombarded by with ions. These layers also act as foggy mirrors. The stronger the ionization, the better the reflecting ability of the layers.

The higher we go in frequency, the higher the layer that will reflect our signals. This is why we have such a short range on 80m, and such a long range on 10m. The higher the layer doing the reflecting, the further the signal is going to be reflected. And then we're helped by it bouncing back and forth between the ionized layer and the earth's reflection, giving us multiple bounces.

And this is why, during sunspot minimums, the higher layers don't get enough ions from the sun to reflect our signals, so 10m dies, and even 20m is lousy at night. As soon as the sun's ions stop zapping the ionosphere, it starts to disperse, hence the different propagation at night. The higher layers disperse the easiest, so 10m fades out at night, even in very high sun spot parts of the 11-year cycle.

Once we get above the highest frequency these layers can reflect, which we call the Maximum Usable Frequency (MUF), we're up in the VHF and UHF bands and antennas are simpler to deal with.

On the lower bands you have two needs. One is to be able to hear signals from all directions when you want to. It's nice to have a clue as to what areas of the world the ionosphere layers are favoring. But then you want to concentrate as much energy into the one single direction as you can so you can be heard, and can hear the chap you're trying to contact and cut down on the signals from other directions. This is tricky. You want to concentrate your energy both horizontally in as narrow a beam as you can, and also vertically, aiming it upward at an optimum angle to bounce off the ionosphere. And that vertical angle is always changing as the layers go up and down, and different layers come into play at different heights. The ideal DX antenna would be steerable both vertically and horizontally. Well, that isn't difficult for the UHF bands, where your antennas are small. A half-wave at 2m is about 38" while at 20m it's obviously ten times that, 32 feet. That's beyond what we can practically do with an az-el rotator. Azimuth (horizontal). Elevate (vertical). We use those mostly for our satellite communications up on the VHF and UHF bands, where we zap right through all those ionosphere layers.

One of the problems with this vertical angle deal is that an antenna which works great during the high sunspot years because it has a particularly low angle of radiation, is a dud when the sunspots are low and the lower layers less ionized. For instance, the W8JK "Twin-Three" wire beam is a marvel during the high sunspot part of the cycle. It has a very low angle of radiation. I knocked the socks off the Big Signal boys with their yagi beams with this simple wire antenna. It's just a couple of dipoles spaced 1/6th wave apart. It's bidirectional horizontally, and doesn't have much more horizontal directivity than plain dipoles. But it had a very narrow vertical angle, and very low. The result was that my signal would be the first heard when the band was starting to open, and the last to fade out. But while the band was wide open, I was outdone by the yagi antennas.

So when everyone was working Europe, I'd call CQ the Middle East or the Indian Ocean. When everyone was working the Pacific Ocean and Japan, I'd be working far into China, South Africa and the Middle East the long way around. I remember working W5IMW portable in Tsientsin, China, running a quarter watt (AM!) to modulated signal generator into a longwire antenna. He

Continued on page 45

The "J" Antenna

An oldie but a goodie.

Dale R. Kubichek N6JSX/9
1305A South 13th Street
Manitowoc WI 54220

The "J" antenna goes back many years, long before I became a ham. There are a bunch of reasons why you're going to want to build one of these beauts:

- It has a low, relatively straight-out angle of radiation.
- No ground plane is required.
- You can use it on several bands.
- It may have separate feeds for each band.
- It's very easy to make.
- It's inexpensive to make.
- It's fine for mobile, marine, or home use.

I run 2 meters and 220 MHz in the car, and I prefer a solid gutter mount over magnetic mounts. A 5/8- or 1/4-wave whip antenna on the gutter only has half of the car's body to act as a ground plane, but the "J" requires *no* vehicle ground plane.

The "J" is the *best* antenna for flatlanders, giving the most distance to your transmitted signal. This is due to the exceptionally low, to nearly flat, angle of radiation of about 0°-2°. The other, more common, antennas give much higher radiation angles; that may be good for mountaintop elevated repeater sites but will shorten your overall flatland transmitting distance. The 5/8-wave whip has about a 4°-6° radiation angle and the highest radiation angle comes from the 1/4-wave whip that has about 5°-10°. The "J" has approximately 3 dB of gain over a quarter-wave ground plane antenna and 6 dB over an isotropic (theoretical) antenna. The "J" can be made from almost any material: copper pipe, steel whips, and even 300 ohm TV twin-lead.

Technically, the "J" antenna is an end-fed half-wave antenna that uses a quarter-wave matching stub. Old-timers might call it an "end-fed Zepp," bent 90°. In actuality, the conductor is three-quarters of a wave long and the remaining section is a quarter-wave long. The matching stub creates the tuned half-wavelength antenna. Because the matching section acts as the matching transformer/balun, the half-wave radiator sees the lower quarter-wave

"The "J" is the* best *antenna for flatlanders, giving the most distance to your transmitted signal."

	146 MHz	223.5 MHz	446 MHz	
1/4 Wave	19.3"	12.6"	6.3"	computed
1/2 Wave	38.5"	25.1	12.6	values
Radiating Element	57.5"	37.5"	18.5"	
Matching Element	19"	12.5"	6"	
Coax Taps				
Combo 2m/220	5"	2.25"	n/a	
Combo 2m/220/440	4"	1.75"	1.25"	
Spacing Between Elements (ID)	1.5-3"	1-2"	0.75-1.5"	

(The spacing ID can be as small as 1/4", but the coax taps' dimensions will be affected.)
NOTE: These same dimensions are also good for monoband designs—specifically for copper pipe "J"s.

Table 1. Copper Pipe "J" Antenna Dimensions

	144 MHz	220 MHZ	
Radiated Element	57.5"	37.5"	
Matching Element	19"	11.75	No tuning required
Coax Taps	3.75"	1.5"	No tuning required

Table 2. TV-Twin "J" Antenna Dimensions

matching section as an image of a false ground plane. In best terms, the "J" is a balanced quarter-wave matching stub feeding an unbalanced half-wave load. The feedlines to a "J" can be almost anything (ladder line to coax). Through experimentation, I found RG-58/U coax to be quite satisfactory.

The "J" antenna designs I have built and tested are:

- 3/4", 1/2", & 3/8" copper pipe
- 144 & 220 MHz combo
- 144, 220, & 440 MHz combo
- 2m modified CB whip gutter mount
- 2m & 220 TV twin-lead 300 ohm
- 144 MHz monoband
- 220 MHz monoband
- 430 MHz Beacon/ATV monoband

The "J" antenna can be made of common 1/2" rigid copper pipe with copper tees and 90° elbows. These copper parts, plumbers' flux, solder, and propane torches can be obtained at most hardware stores. Copper pipe is easy to solder, which makes assembly a snap, and these materials will withstand a lot of abuse and weather.

Modified CB whip "J" antenna

For a mobile 2m "J," I used a Radio Shack™ 102" CB whip and cut it down to size. The whip comes with a 3/8" x 24 mounting bolt attached to the bottom of the whip that fits nicely into most Radio Shack (gutter, ball, or mirror) mounting clamps. I made the plastic insulators and metal support brackets. I drilled the electrical split-bolt connectors to slide on the whip and give mobility to the coax attachment for adjusting VSWR.

I've modified my initial 102" CB whip "J" antenna design even further by welding an "L"-shaped 10 gauge bent metal rod matching section only about one inch away from the whip. The bottom of the "L" was welded to the whip bolt-head making a clean, sturdy construction. This eliminated the metal support bracket fabrication and made the antenna more aerodynamically stable, reducing wind loading and stress on the vehicle mounting point. I found the other metal support bracket loosened due to vibration and excessive wind flexing of the antenna.

"The portable version can be rolled up into a coil and stored in your desk drawer, or even carried in your pocket."

Triband copper pipe "J" antenna

On the three "J" antenna combo, I took the matching elements and placed them 120° from one another. This appears to help eliminate crossband RF desensitizing. Tune the 440 section first and then the 220 section with the 440 section disconnected, and so on. The rigidity of the copper pipe means that insulators between the matching stubs will not be required to keep the elements equidistant. Use silicone on the antenna feed points and coax for weather protection. After building this triband "J" antenna, one apartment-restricted ham took this design, added a copper pipe stand to the base of the combo antenna, and made it a hat/coat rack in the corner of his apartment. He ran the three coax cables along the mop boards to his ham desk, and he claims the antennas still work well even with a few coats hanging from the "J" elements. See **Table 1** for measurements.

Emergency portable "J" antenna

This antenna can be rolled up into a coil and stored in your desk drawer or even carried in your pocket. With a rubber band, paper clip, or thumbtack, the "J" antenna can be suspended anywhere. This antenna makes a fantastic sneaky "hidden transmitter antenna," and building it is easy. You'll need:

- 60" common TV twin-lead
- RG-58/U coax (multiples of odd 1/4 wave length)
- Coax connector (PL-259 or BNC type for HTs)
- Soldering iron
- Paper hole punch

See **Table 2** for 144 and 220 MHz antenna dimensions.

Install tap-offs at the indicated points and trim the matching element in small increments until you have the best SWR. Be sure to add a little length to the matching element if you're going to tweak the SWR. I have placed a TV-Twin "J" inside PVC plastic tubing for weatherproofing and making a rigged antenna. Paint the tubing black, put a hook on the top, and you have an invisible nighttime antenna. (The PVC tube *will* interact with the "J" so special tuning is required.)

Special note: Since 1984, when I began pushing the "J" antenna design in *ALLUSA* packet articles, I have seen many published articles covering the TV-Twin-lead "J" with many different antenna dimensions. What I've been able to discover is that the length of the coax attached to the TV-Twin-lead "J" directly affects the dimensions and performance of the "J" antenna. However, using a bazooka balun (i.e., tuned RF coax shield choke) at the feed point of the coax seems to nullify the variable effects of random lengths of coax.

"J" beam antenna

A copper pipe monoband "J" is the basic foundation for my extended three-element "J" beam design. This beam can be made from any monoband "J" design. See **Table 3**. My extended three-element design gives nearly as good a performance and gain (about 6 dB) as a four-element antenna. The matching element can be as close to the radiating element as practical (but any variance in this dimension will directly affect the coax

	144 MHz	220 MHz	440 MHz	434 MHz
Director Element	36.5"	23.9"	12.0"	12.3"
Reflector Element	40.4"	26.5"	13.2"	13.6"
Director Spacing	20.1"	13.2"	6.6"	6.8"
Reflector Spacing	12.25"	7.9"	4.0"	4.1"
Center - 1/2 Wave	19.25"	12.6"	6.3"	6.5"

Table 3. "J" Beam Antenna Dimensions

taps.) The antenna offers good directivity and the potential for some interesting mechanical methods of changing beam bearings. Remove the pins from the PVC, and the beam makes a great rotating hidden transmitter antenna. I have rigged this beam for a constant (2 rpm) slow rotation (using a 12 VDC windshield wiper motor), making the signal bounce and scatter all over the hills. I used a glass marble for a mock bearing between the top of the radiating element and the PVC end cap.

Since moving from my California home in 1993, I've been living in an apartment, unable to use outside antennas. I use "J"s for all my VHF/UHF/packet operations inside the apartment. Placing the antennas in the corners of the living room, hanging the "J"s from curtain rods (behind curtains), or using a TV-Twin "J" thumbtacked to the roof of the patio room allows good ham communications, and I can keep my PTM packet mini-BBS station (in Manitowoc, Wisconsin) on the air. The "J" antenna offers the foundation for stealth antennas; by placing the antenna in PVC, with a little paint and an angled mounting box, the antenna can look like a gas/sewer breather pipe on the roof of an apartment or CCR restricted house. I have found the 3/4" copper pipe "J" to have a broader bandwidth, and it's extremely sturdy, making it a good high-wind area antenna when solid coax attachments are ensured. A coat of polyurethane will keep the antenna bright for years.

Other good "J" antenna designs that have been published in *73 Amateur Radio Today* in recent years (in my opinion, the best "J" designs, offering the greatest potential, are the 2m & 440 dual-banders):

- "Copper Cactus J-Pole" by KE7AX, February 1992.
- "Copper Dual-Band Super J-Pole Antenna" by KAØNAN, April 1993.

Other interesting designs are:

- "220 Super J-Pole Antenna" by KAØNAN, May 1996.
- "440 Super J-Pole Antenna" by KAØNAN, April 1996.
- "Simple J-Type 10m Vertical" by W6IOJ, September 1995.

NEVER SAY DIE

Continued from page 42

said I was the only one on the band he could hear.

Twin-Threes got to be fairly popular during the high sunspot part of the cycles, and then died when the spots died down. By the next cycle they'd all been replaced by higher angle radiators, so eventually the Twin-Three has been lost in history. You don't even see it in the antenna books any more.

Ham Myths

An editorial in *Florida Skip* decried the decrease in technical competance brought on by the opening of the gates to no-coders, who the author, John Weatherly AB4ET, claims are flooding our bands. Alas, John, not having been licensed for long, has no way of comparing today's hams with those of yore. Having been there in yore, I know all about the vaunted technical competence of that era.

What a bunch of mitigated crap. The hams of the 1930s didn't know squat. They built their transmitters by copying articles in *QST* and *Radio*. Sure, back in the 1920s hams built their own receivers. But as soon as the first commercially made receiver hit the market they all stopped building and bought them. They had to build their own transmitters up until WWII because there no commercially made transmitters. Well, hardly any. Yes, National made a National 600 in 1939, but it was $600 and ran 600 watts. And that's like about $12,000 in today's dollarettes. It was a nice rig, with 100THs in the final. Thordarson power and modulation transformers. Nothing but the best, but not exactly what the average 6L6-using ham was looking for.

The big rig of the late 1930s was the QSL-Special, 6L6Gs on a chassis the size of a QSL card, with plates running red hot with the key down.

When I got interested in hamming I was a 14-year old kid, so I marked a map of Brooklyn with the location of every ham in the *Callbook* and I set about visiting as many of them as I could, zipping around the borough on roller skates. I listened on 160 and visited. I listened on 40m. 10m. There wasn't much doing above 10m, which was the microwaves of the day. I visited around a hundred hams and talked with them.

Here's a report on what I found in 1937-8. I found one ham who had built his own receiver. One. The rest had built their transmitters, but they had little understanding of what was going on in them. After they finished building their rig many of them had to bring it over to Cy W2IXY to see if he could make it work. His main piece of test equipment was a neon bulb.

So let's not perpetuate the myth of ham technical competence of yore, using it to try and make newcomers feel guilty and inferior.

The flood of war surplus in 1946 did more to help build ham competence than anything

Continued on page 69

Automatic Voltage Controller

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Did something blow up in your regulated power supply and suddenly feed 25 or 30 volts into your expensive solid-state transceiver? Did you ever damage a storage battery by draining it completely? Here is a simple circuit that will cost only about five dollars to build, and will prevent damage to your equipment should your DC source voltage vary outside safe limits. The limits are defined usually as being +11.2 and +15 volts DC for most solid-state ham equipment.

This circuit can be thought of as a tireless "robot" that continuously monitors the DC voltage level of the power source for the ham station, whether storage batteries or regulated power supply. Because solid-state equipment can be damaged by excess voltage, and may not function properly when the supply voltage is too low, this "robot" will remove the DC voltage from the station equipment immediately should the voltage vary outside safe limits. At the same time, it will alert the operator with a red LED, and a bell or piezo warning, if included as an option. Thus, repairs and adjustments can be made immediately to bring the DC voltage back to safe levels. At that time this "robot" reconnects the DC voltage to the station equipment and indicates that all is well by turning off the red LED and the optional audible alarm and by illuminating a green LED. Operation is entirely automatic. Voltage limits are established by the circuit. Setting two trimpots for each voltage limit establishes calibration for normal operation, as just described.

Theory of operation

Refer to schematic diagram **Fig. 1** for the following discussion. Station DC voltage, a nominal +13.8 VDC, is fed through normally closed contacts of relay K2. This voltage also provides power for the protective circuit illustrated. The voltage appears across R1 and R2, 10k trimpots, the wipers of which are set to exactly midrange, measuring a nominal +6.9 VDC. As the station DC varies between +11.2 and +15 volts, the voltage at the wipers will vary from +5.6 to +7.5 VDC. Zener diode D2 controls the high voltage limit of +15 VDC. R5 and zener diode D4 controls the low voltage limit of +11.2 VDC.

High voltage limit control

A voltage is fed from the wiper of R1 directly to the base of Q1, which is held cut off by the 7.5 volt zener diode D2 from the emitter to ground. Thus, relay K1 is not energized, and its normally open contacts prevent relay K2 from being energized, thus allowing station DC current to flow through K2's normally closed contacts to the station equipment. However, should the station DC voltage rise to or above +15 volts, the voltage at the base of Q1 also rises to or above +7.5 volts, causing Q1 to go into conduction, energizing K1, its collector load, whose normally open contacts close, energizing K2, whose normally closed contacts open, removing the voltage from the station equipment. While the station DC voltage is between normal limits, the green LED D6

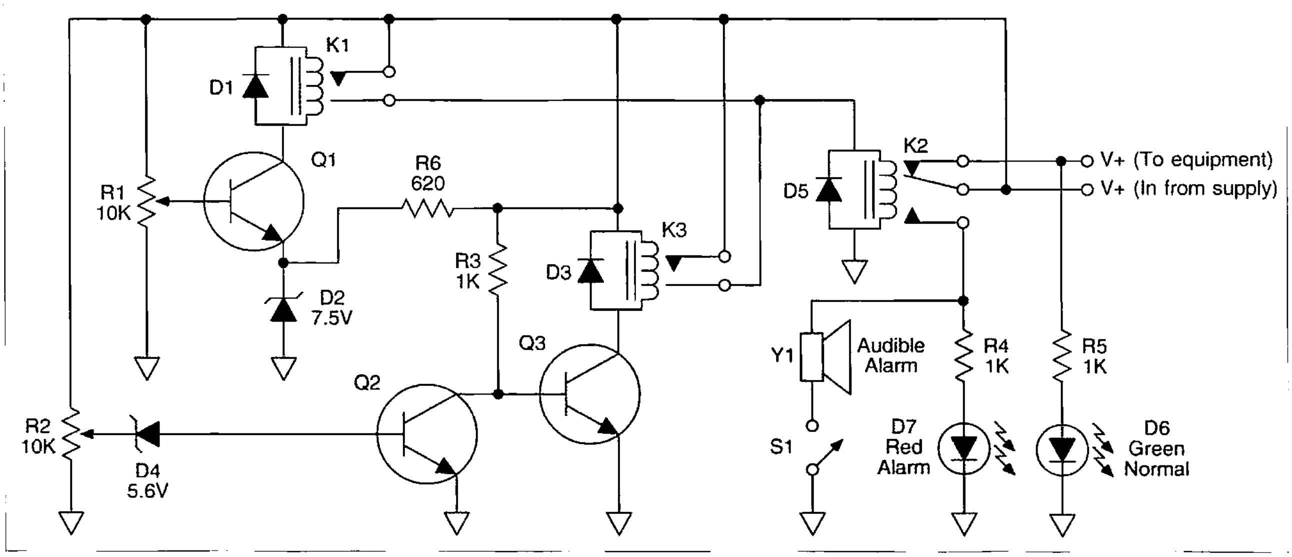

Fig. 1. Automatic Voltage Controller

will be illuminated, being powered through normally closed contacts of relay K2. When the voltage exceeds the high limit of +15 volts as described above, and relay K2 is energized, it removes voltage from the station equipment, the green LED D6, and applies power to red LED D7, and the audible bell or piezo alert, Y1, thus warning the operator of a power malfunction.

Low voltage limit control

A voltage is applied from the wiper of R2 to the cathode of zener diode D4 which conducts, causing Q2 to saturate. The collector of Q2 is connected directly to the base of Q3, which is cut off. Relay K3 is the collector load for Q3, and thus is not energized. Should the voltage fall to or below +11.2 VDC, zener diode D4 ceases to conduct, cutting off Q2 which causes Q3 to conduct, energizing K3. K3 applies operating voltage through its now closed, normally open, contacts to the coil of relay K2, which operates, opening its normally closed contacts, removing voltage from D6, the station equipment, and applying power to red LED D7, and the audible alert.

As described above, while station voltage is within the normal range, the green LED D6 remains illuminated. However, when the voltage falls outside the limits and relay K2 removes power from the station equipment and green LED D6, the normally open contacts of K2 apply power to red LED D7 and the optional audible alarm. Capacitor C1 damps relay chatter when the supply voltage is at either limit.

Construction

This instrument should be constructed in a metal or plastic case, with the LEDs on the panel where they will be easily seen by the operator. The optional piezo alert or 12-volt bell can be placed anywhere convenient. The toggle switch shown in **Fig. 1** should be included if an audible alarm is used, to cut it off until repairs can be made.

Relay K1 (high voltage detector) is actually a SPDT 6-volt relay with a 220-ohm coil, with only the normally open contacts used. Just about any 6-volt relay could be used, but I recommend this one for its characteristics and price. (All Electronics, PO Box 567, Van Nuys CA 91408-0567. Cat. No. RSD-6V. $1.00.) It is rated for 4.3 to 14 VDC, and where I used it in the circuit, the 4.3-V pull-in is important because of its rapidly operating to energize K2 and removing over-voltage.

Relay K2 (main power cut-off) is a 12 volt relay, and SPDT is required. The contact rating will be governed by the maximum current your transceiver draws from its power source. Of course, double-, triple-, or quadruple-pole relays can be used by strapping the contacts together to increase current carrying capacity.

Relay K3 (low voltage detector) has very little work to do, and can be any small 12-volt SPST N.O. relay, or an SPDT using only the normally open contacts. Any of the transistors listed in the parts list can be used. All of these will tolerate up to 6 volts between base and emitter, and a couple are rated for 7 volts.

Internal wiring can be any small hookup wire. Only the leads from your power supply to K2, and the lead from K2 to your station equipment must be commensurate with the current they carry, and the round-trip distance they traverse. The lead to station ground carries very little current. Check all wiring and connections against the schematic. Be certain!

Calibration

Adjust R1 and R5 to about the center of their rotation limits. Apply a DC voltage variable between at least 11.2 and 15 VDC between the top of R1 and ground. Set this voltage to 13.8 VDC. The green LED should illuminate. If it does not, adjust R1 wiper towards ground, and/or R5 wiper towards the positive end. When the green LED is illuminated, follow the directions below to set the desired voltage limits.

- **High Voltage Limit**

Set the variable DC voltage to 15 VDC, or the voltage you choose as high voltage limit. Use a DMM if at all possible for the greatest accuracy. Adjust R1 until the green LED goes out and the red LED illuminates. Set this point accurately to where the red LED just illuminates.

- **Low Voltage Limit**

Set the variable DC voltage source to 11.2 VDC or whatever voltage you choose as your low voltage limit. If the green LED is illuminated, adjust R5 until it just goes out and the red LED illuminates. If the red LED is illuminated, adjust R5 until it goes out, then carefully adjust R5 until the red LED illuminates.

Operation

Operation is entirely automatic, with automatic reset. Adjustments, other than the initial calibration described above, are neither necessary nor possible. This is as idiot-proof as it was possible to design it.

Conclusion

This is a junk box project for most hams, and whatever isn't in the junk box can usually be found at hamfests and Radio Shack™, or from other hams and the many mail-order parts suppliers. A piece of perfboard or a small universal board such as the Radio Shack 276-150 can be used to mount the small parts, including K1 and K3, most likely. But mount it in a metal or plastic enclosure to make certain nothing metallic can fall across any relay contacts.

With this tireless "robot" guarding your expensive solid-state equipment from dangerous and expensive voltage excursions, you are also protecting your wallet from unnecessary and easily avoidable expenditures.

Parts List

C1	25µF 50V electrolytic
D1, D3, D5	IN914, IN4148
D2	7.5V zener
D4	5.6V zener
D6	Green LED
D7	Red LED
K1	6V SPST N.O. 220Ω coil (see text)
K2	12V SPDT, heavy contacts (see text)
K3	12V SPST N.O. relay
Q1, Q2, Q3	NPN 2N2102, 2N2218A, 2N2219A, 2N3904, 2N4401, 2N5320 (see text)
R1, R2	10 KΩ trimpot
R3, R4	1KΩ 1/4W 5%
R5	620Ω, 1/4 W, 5%
S1	SPST toggle or slide switch (optional)
Y1	Piezo alert, 12V bell, etc. (optional)

Receiver RF Preamp

There is a way to improve that old receiver's performance.

Roland Burgan KB8XI
RR 1, Box 43
Hancock MI 49930

Have you ever wished that you could improve the performance of that older receiver you have sitting on the shelf, but couldn't find an easy way to do it? Over the years, many of us have looked into various ways of improving vintage receiver performance, but improving one aspect often came at the expense of introducing other problems. And as solid-state devices came along, we discovered that low voltage DC wasn't generally available in the tube-type equipment, often putting the final damper on the project.

But there is a way to improve performance. The circuit described here is simple, small, and can easily be accommodated in most receivers. It will provide 30 dB of broadband RF gain to the receiver's front end, at extremely low internal noise figures. The parts are readily available, and it can be built for less than $10.

The circuit

The RF broadband preamplifier (**Fig. 1a**) makes use of an NPN VHF transistor, NTE123, as an untuned broadband (0.5 MHz to 30 MHz) RF amplifier. Input impedance is 50 ohms, allowing usage for all receiver inputs, and the unit has a 600 ohm output to match virtually all RF input circuits. The preamp delivers 30 dB of gain at 10 MHz, with a noise factor below 1 dB.

Power for the preamp may be obtained from a variety of sources. The assembly requires from 9 to 14 VDC and draws 8 mA of current. This makes it ideal for use in battery-operated portable equipment. Early tube-type receivers used filament voltages of 6.3 and 12.6 VAC, but had no low voltage DC power supplies. **Figs. 1b** and **1c** show how to "borrow" a little of the filament voltage, which is rectified and regulated to provide filtered 12 VDC for the preamp. In the 6.3 VAC version, diodes D2 and D3 act as a simple voltage doubler to step the input voltage up to approximately 15 VDC.

While the 220 µF caps used for the voltage doubler are sufficient for the load presented by this preamp, they will not provide the +15 VDC to the input of the regulator at more than about a 25 mA load. If other circuits will be used with these DC power sources, then the 220 µF caps should be increased accordingly. (2200 µF will provide about 65 mA regulated output).

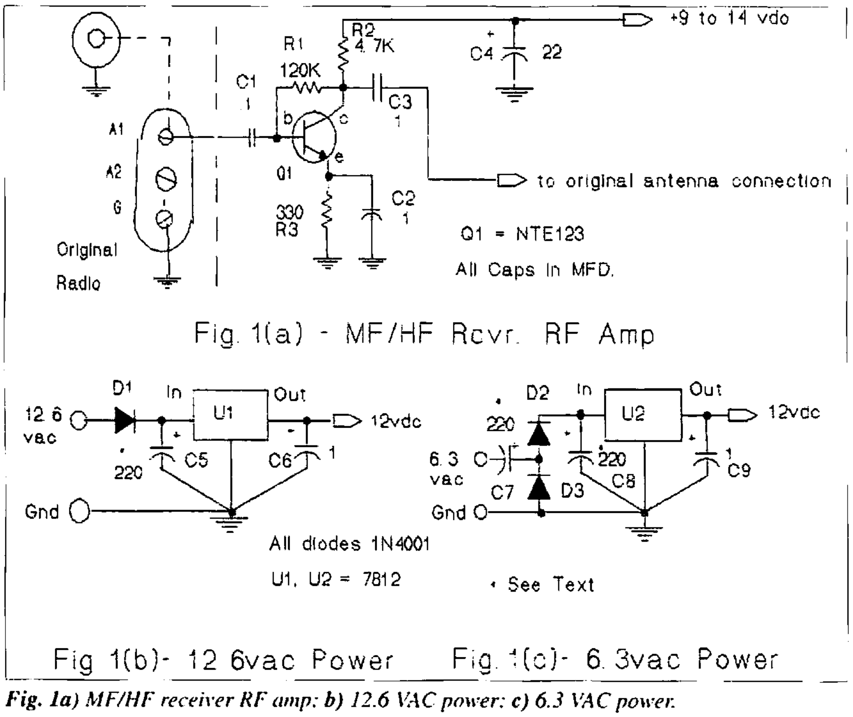

Fig. 1a) MF/HF receiver RF amp; b) 12.6 VAC power; c) 6.3 VAC power.

Construction

In my installations, I make up two separate PCBs, one for the preamp, and another for the power circuit, to make better use of internal mounting space. The preamp should be mounted as close to the antenna input as feasible. Construction is not critical, and point-to-point construction may be used. Most preamp mountings will require nothing more than a right angle clip, while the power boards can usually be mounted to a back panel with standoffs. All other parts are standard values, but electrolytic caps should be rated at 35W VDC. Please note that the collector of Q1 is also internally connected to the metal external case.

The author may be contacted by mail (enclose an SASE) at the address above, or via E-mail at: rburgan@grfn.org .

Parts List

R1	120k, 1/8W	Mouser, Radio Shack
R2	4.7k, 1/8W	Mouser, Radio Shack
R3	330k, 1/8W	Mouser, Radio Shack
C1, C2, C3	0.1 µF, 50V	Mouser, Radio Shack
C4	22 µF, 35V	Mouser, Radio Shack
C5, C7, C8	220 µF, 35V	Mouser, Radio Shack
C6, C9	1 µF, 35V	Mouser, Radio Shack
Q1	NTE123 (NPN transistor)	Mouser
U1, U2	7812 (1.5A Pos. 12V reg.)	Mouser, Radio Shack

Photo A. Rosalie White WA1STO with Matt Bordelon KC5BTL, a

Number 49 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
Media Mentors Inc.
P.O. Box 131646
Staten Island NY 10313-0006

Dayton HamVention '96

The Dayton HamVention is an event I look forward to all year round. This year I was particularly excited about moderating the Instructors' Forum on Friday afternoon. I had put together an impressive group of talented speakers, and I couldn't wait to meet with them. Besides being experts in their own areas, they are all high on my list of great folks I look forward to seeing.

At this yearly forum we attempt to present a variety of ideas, suggestions, and proven techniques to share with other teachers. Both classroom teachers and instructors in licensing classes can really get some good practical ideas at this workshop.

First I introduced Rosalie White WA1STO, head of the Educational Activities Department at the ARRL. She presented an overview of the package of materials that the League has to offer the teacher. I've personally used so many of the great lessons, charts, guides, etc., from this package of materials that I can vouch for their excellence. There is a wealth of information about amateur radio out there. The ARRL Education Department is a good place to begin gathering your data. Ask for Rosalie or anyone else in her department for assistance in getting a radio program started.

Next to speak was Ellie Van Winkle NØQCX, from Boulder, Colorado. Ellie is a retired kindergarten teacher whom I met four years ago at Dayton. We bonded instantly, and have had great success working together for the Dayton Youth Forum. She and her husband, Rip NVØM, created the BARC Jr. club for youngsters interested in ham radio. This group is one of the most successful youth groups in the country.

"Ellie and Al Severson WB2PRZ spoke about how to have successful fund-raisers."

Ellie and Al Severson WB2PRZ spoke about how to have successful fund-raisers, an important issue to any growing club that needs to support its members in different activities. Since BARC Jr. sent four children to participate in my Youth Forum this year at Dayton, they really had to get well organized in their fund-raising efforts. Besides having swap tables, raffling a donated bicycle, and soliciting donations, BARC Jr. also received a donation of frequent flyer miles, which helped defray the airfare. It was apparent to all in attendance that the dedication of the parent club, BARC, is a major factor in the success of the children's group.

Bob Heil K9EID, one of my favorite professor-speakers, wowed the audience with his antenna theory demonstrations. He used two microphones to demonstrate phasing, along with a dramatic flashlight-phasing demo. Bob is the recipient of many awards including the 1982 "Ham of The Year" award and the Pioneer Award for his groundbreaking work as a sound systems developer and engineer for such major groups as The Who, Peter Frampton, The Doobie Brothers, and many more.

Bob is so enthusiastic about the role of teachers in amateur radio, it's always a pleasure to have him as a guest speaker.

Bill Pasternak WA6ITF, who is the author of hundreds of technical articles, and was the 1989 "Ham of The Year," spoke about why he created the "Young Ham of The Year" award. He felt it was important to honor youngsters who were actively contributing to the hobby. Bill spoke about the qualifications for nomination and how to get an official entry form. For more details about this contest, contact Bill at 28197 Robins Ave., Saugus CA 91350, or telephone 805-296-7180.

The Instructors' Forum is always informative and fun to attend. Why not plan to attend next year?

Number 50 on your Feedback card

HAM TO HAM

Your Input Welcome Here

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In "Ham To Ham" in the June 1996 issue of *73*, I mentioned a practical use for those small laser pointer pens—using one to help locate a soldering pad on the foil side of a circuit board by shining its beam over the part to be unsoldered on the component side. I asked for other interesting uses, and I received this from **Harry SMØVPO** in Upplands, Sweden: "Those little laser pointers are about the easiest way that I know of to catch a fly! That's right, just shine it on the little bugger's head and it can see nothing else but the laser; now you simply pick it up! If you've ever wanted to catch a live fly—without damaging it—for study under a microscope or for macrophotography, this is the best method I've found ... I even have the pictures to prove it!"

Now there's a novel use ... from the land that gave us the zipper!

Well grounded!

Here's an easy "quick modification" to keep in mind the next time you have your ham transceiver—or other accessory piece of gear—apart on your workbench. Check to make sure that the area on the inside of the metal cabinet covers is capable of making good ground contact when the cabinet covers are fastened back into place. It may seem obvious at first, but I've noticed that most ham manufacturers are guilty of "over-spraying" the insides of the cabinets during the cabinet spray-painting process. This over-spray can vary from very light to quite heavy ... depending upon luck, I suppose. At any rate, sanding, scraping, or otherwise cleaning the areas on the cabinet's inside can sometimes increase the RF shielding properties of the enclosure dramatically.

Those areas, especially around the screw holes, should be scraped clean—down to shiny metal—of any paint over-spray in order to assure good RF ground contact when the outside screws are tightened. I like using a small, hand-held "motor-tool" (such as the one made by Dremel) with a conical burr-style grinding bit in it for the job; it makes it fast and accurate.

Remember, what might be a reasonably adequate ground at DC and audio frequencies may not be effective enough at RF frequencies, especially at the VHFs and beyond. A little effort brings a lot of peace of mind.

An unwelcome battery load

Erich Kern of Murrieta, California, wrote:

"It was interesting to me to read your piece on conductive adhesives in the November 1995 'Ham To Ham' column. I, too, have had occasion to encounter the same effect, but with masking tape instead.

"About 20 years ago, I learned quickly that some masking tapes can become semi-conductive after a time, creating unexpected leakage paths. In my case, I was using the masking tape to cover the exposed terminals of spare 9 volt batteries, only to find that the tape eventually became partially conductive—measuring about 20k ohms with the probes spaced 1/2 inch apart across the tape. Needless to say, the 'protective tape' was also discharging my spare 9 volt batteries! It's difficult to say whether the tape adhesive was the culprit (after it dried out to some degree) or if the paper-based masking tape merely picked up moisture from the atmosphere and then became a semiconductor. Whatever the reason, others should be aware that the problem can and does happen under the right (?) conditions."

Moderator's note: In the May 1996 HTH column, I made the suggestion of using Johnson & Johnson's 1/2-inch-wide waterproof First Aid tape on conductive pathways, instead of other tapes that might become hygroscopic or otherwise semiconductive with time. I've been very happy with this product in my own equipment so far. Are there any other tapes that readers have used with long-term success, ones that don't become goopy after a while? Also, I ran into the conductive adhesive pitfall again. This time it was in a computer color monitor that I purchased at a local hamfest. The manufacturer had used an adhesive on some of the components that he didn't want to move during shipping, but, with time, it began to get semiconductive when it hardened. It became noticeable in the horizontal deflection section of the monitor, causing the width of the screen's raster to change unpredictably from time to time. Once I removed the problem adhesive (which had become very hard, brittle and probably hygroscopic), the problem was corrected ... Murphy strikes again! 100% silicone bathtub sealant seems to be best for holding down heavy parts on PC boards: it will last virtually forever and doesn't pick up moisture. Just take care to let it cure for the time recommended by the manufacturer before applying power to the circuit, and don't use it directly on the copper foil itself because of the acidic chemicals that it contains.

Ridin' the rails

I ran across a product that model railroaders often use, but which may also have practical application within ham radio. It's called Rail-Zip™ and is made by Pacer Technology, 9420 Santa Anita Avenue, Rancho Cucamonga CA 91730-6117 (1-800-538-3091). It's a multi-purpose liquid product that cleans, lubricates, conditions, and protects metal surfaces from mineral scale and rust.

I've used it on a small Z-gauge layout that I have, and it seems to work. Model railroad track has the tendency to become a poor electrical conductor due to the "micro-sparking" (my term) that goes on between the engine's pick-up wheels and the track every time it's run. Rail-Zip is supposed to penetrate the corrosion that's behind this tendency, and restore proper conductivity. It's also claimed to help prevent new corrosion, which will minimize future sparking for 8 to 12 weeks. Sound like it might be useful for connectors and switch contacts in our ham gear?

I wrote to Pacer, out of curiosity, and this is a paraphrased summary of their reply:

"Rail-Zip penetrates to produce a clean metal surface, leaving an organic barrier that prevents further scale from forming. It's formulated for use on all metallic surfaces, and is pH stabilized, water soluble, and safe around plastics. An oxygen scavenger works as a corrosion inhibitor to prevent cavitation, erosion, and pitting on metallic surfaces. It's completely organic, biodegradable, environmentally safe, and non-toxic to handle. Though not tested on connectors and switches used in amateur radio equipment, we feel that it will restore the electrical conductivity of them, and provide a corrosion barrier as well."

It might be worth keeping in mind, especially for outdoor antenna connections where corrosion can often be a big factor in intermittence: Rail-Zip is available at hobby stores and via mail-order from catalogs that cater to the model rail hobby.

The right packet path

From William Thim N1QVQ: "Having been involved in VHF packet for a couple of years now, I've become conscious of a lot of hams who might be newer to that mode, questioning on 2 meter packet and voice what's available in the way of node hopping, BBSs, HF gateways, etc. in our area. I usually jump in and try to help with tales of my own experiences, but if it's on a repeater, more often than not the station is mobile, and unable to write down the information that I might have to pass on.

"In view of that limitation, I've taken to placing special information messages on my home PBBS, addressed to ALL, but only within my home district. A short description of the subject also helps, such as NODE HOPPING or perhaps HF GATEWAYS. I know that a significant number have benefited from these messages, and I've benefited myself with additional information coming back to me

from others who know of paths that I wasn't aware of. It pays to share!"

Freebie sealant!

From Bob Boehm N8EXF: "Here's a readily available source of sealing compound for those outdoor coaxial cable connectors or weather-exposed antenna relay control boxes ... and it's free for the asking. It's the windshield edge sealant used by the aftermarket automobile windshield replacement guys that you see in people's driveways, replacing damaged windshields right on location. I was able to acquire a nearly unlimited supply of this sealant simply by asking one of the repairmen for any 'tail-end' rolls that he had lying around: rolls that usually just end up in the dumpster.

"Since locating this 'free' source, I've been using it exclusively for the past six years on all of my outdoor coax connections. While it isn't 'flat' in its acquired form, it's easily reworked, with just the fingers, to make an effective sealant for even the tightest of nooks and crannies. If you're worried about any adverse chemical reactions between the sealant and the metal on the connectors, simply wrap the connector first with one layer of electrical tape before applying the auto window sealant. It also makes for a 'cleaner' removal should you ever want to open the sealed connection for some reason. You can't beat the price, and it gives you a chance to tell a prospective newcomer (the windshield repairman) about the wonders of the world of ham radio!"

Broaden your scope!

From Michael Fratus: "Even an inexpensive oscilloscope can be made to act more like one of the very expensive ones with a little ingenuity! Many of the 'big dollar' scopes offer on-screen voltage and frequency measurement as part of their selling points, but you can have nearly the same features for a lot less money.

"By using a couple of inexpensive BNC 'T' connectors on the scope's input, you can easily hook up both your DVM and your external frequency counter, so that you'll have a voltage and frequency reading—along with the scope presentation—wherever you place your scope probe during troubleshooting. It's a good deal easier than trying to read DC voltages by the amount of bounce on the scope trace, and frequency by converting microseconds into megahertz! And it surely beats paying $8,000 for a later-model scope!"

Parts hunting made easy

From Peter Albright AA2AD: "One of the greatest challenges in any servicing endeavor (ham radio equipment included) is in identifying parts and finding serviceable replacements for defective ones. The manufacturer's technical service manual (of course) should be consulted first, if available, but what if you don't have access to one? My favorite semiconductor cross-reference is the EGC Master Replacement Guide, which is just chock-full of semiconductor data in almost 'painful' detail! It's less than $10 if purchased new, but it can sometimes be acquired free from service shops (when a new one comes out) or from some parts dealers, if you're a high enough dollar customer. ECG is a division of North American Philips Corporation, and you can contact them at: Philips ECG, 1025 Westminster Drive, Williamsport PA 17701. Incidentally, the ECG parts numbering system has also been adopted by several other 'generic' parts suppliers.

"The SK semiconductor parts series (from the former RCA Corporation) is also often used or quoted in replacement data as something of a standard, very much like ECG. The SK Replacement Cross-Reference is now available from: Thompson Consumer Electronics, 2000 Clements Bridge Road, Deptford NJ 09096-2088.

"Radio Shack also publishes a semiconductor replacement guide. It's available for sale or in-store use at most Radio Shack retail outlets. It usually only details parts actually being currently sold by RS stores, but it also contains a reasonably complete general cross-reference section.

"Because of their widespread presence, I'll often frequent my area Radio Shack stores first, when looking for replacement parts. Their parts are generally name-brands, simply repackaged in single or double lot bubble packs, but you can't beat the convenience and speed of obtaining a replacement in a number of cases. If they don't have what I need, however, I'll turn to the mail-order houses. One of my personal favorites is MCM Electronics, 650 Congress Park Drive, Centerville OH 45459-4072 (1-800-543-4330). They offer a good selection of parts, power supplies, tools, test equipment, computer accessories, etc. in their free catalog.

"Other suppliers that I've used include: American Design Components, 400 County Avenue, Secaucus NJ 07094 (1-800-776-3700); Black Box Corporation, P.O. Box 12800, Pittsburgh PA 152421 (1-412-746-5500); Fox International, 23600 Aurora Road, Bedford Heights OH 44146 (1-800-321-6993); Jameco Electronics, 1355 Shoreway Road, Belmont CA 94002-4100 (1-800-831-4242); Jensen Tools, 7815 S. 46th Street, Phoenix AZ 85044-5399 (1-800-426-1194). Tucker Electronics, 1717 Reserve Street, Garland TX 75042 (1-800-527-4642 Nationwide, or 1-800-749-4642 within Texas) carries a good line of test equipment, ham gear, computers, and accessories.

"The above listing is by no means complete, but I've personally found these suppliers to be reliable, often having the correct parts that I've needed in my repair work."

Moderator's note: In addition to the suppliers Pete mentioned, Digi-Key Corporation, 701 Brooks Avenue South, P.O. Box 677, Thief River Falls MN 56701-0677 (1-800-344-4539) has a thick (free) catalog of parts and semiconductor components for the asking. I've had very good experiences over the years ordering from them and I love the name of that town!

A pin-up beauty!

From Klaus Spies WB9YBM: "Often, when designing a new home-brew item, or if repairing a factory-made piece of equipment, I've done some head-scratching trying to remember the standard resistor values available. But here's a chart that makes it much easier, so I'd like to share it with my fellow builders. See **Table 1.** It applies to both resistor and capacitor standards.

"All of these values are then followed by the appropriate multiplier, for example: 4.7 47 470 4.7K 47 K 470 K 4.7 Meg.

"When 10% resistors were the norm, every other value was skipped, beginning with 1.1, then 1.3, 1.6, 2.0, 2.4, etc.

"Today, with 5% resistors as the norm, the values shown in the chart are commonly available from the larger suppliers.

"For those who might be curious as to how these values were arrived at, this is the mathematical explanation:

"(1.0 + 5%) = 1.05, and (1.1-5%) = 1.045.

This implies that if one value of resistor is at the high end of its tolerance, it will overlap with the next higher standard value. This allows a person to pick almost any value required for a particular project, even if the tolerances are demanding, presuming that you have enough stock in the various values to choose from.

"By the way, experience has shown me that today a new, unstressed resistor is seldom at the

Standard R/C Value Chart—
use multipliers as required:

1.0	1.1	1.2	1.3	1.5	1.6	1.8	2.0	2.2	2.4	2.7
3.0	3.3	3.6	3.9	4.3	4.7	5.1	5.6	6.2	6.8	7.5
8.2	9.1	10.0								

Table 1.

extreme of its tolerance range. In fact, modern metal-film resistors can be almost dead-on many times value-wise."

Moderator's note: I've pinned up Klaus' chart over my workbench—how about you?

Etceteras

If you're looking for a Heathkit part at some point in the future, you can try calling Heath's parts order desk at 616-925-5899. Heath has sold some of its parts stock to Spectrum Electronics, so if Heath itself doesn't have it, then try calling Spectrum at 616-742-0613. This isn't an ad for either vendor: it's simply intended as potentially needed information for fellow hams.

Tape tips

From Steve Thacker KB5VCA: "In my professional career as a superintendent for a mechanical and electrical contractor, I've come upon a number of types of tape for use in outdoor electrical situations, some of which might be of help to my fellow hams. Everyone has probably heard of, and perhaps used, Scotch™ No. 33 electrical tape: it has particularly superior stretching ability in cold weather, won't harm copper or aluminum, and can be sealed even tighter with Scotch 1602 spray sealer. 3M also makes a nice 'splicing' tape: it's a two-sided tape—one side is soft (like a good rubber tape) and the other is much harder and more weather-resistant. It 'cures' over a short period of time into an effective outdoor splice, the harder outside layer taking the brunt of the elements. Other manufacturers may make similar products: the 3M numbers are simply to give readers a point of reference from which they can start. Most electrical supply houses, and now some of the larger home centers, carry these products for shopping ease."

Cheap power zener replacements

From Richard Measures AG6K: "Most HF linear amplifiers have a relatively high-power zener diode in the cathode circuit of their output tube (or tubes) for biasing them into the linear portion of their operating curve and for providing a stable, fixed cathode bias. This zener diode is prone to zapping out, particularly if a high-power VHF parasitic oscillation should occur, because of the large grid-current pulse that always accompanies a VHF parasitic arc-over. It's a costly and sometimes difficult-to-find component to replace. A better solution lies in the use of ordinary silicon rectifier diodes; here's why: 1.) Zener diodes are not adjustable; 2.) Zeners are relatively sensitive to high-current pulses; 3.) And, as mentioned, higher-power zeners are expensive and harder to find.

"Fortunately, the substitution of ordinary silicon diodes addresses all of these objections. Since ordinary power silicon diodes have a stable forward voltage drop of about eight-tenths of a volt DC (0.8 volts) across each diode, a series string of these relatively inexpensive diodes can be cascaded—to make up a stable cathode-bias regulator, for virtually any voltage required. Additionally, this 0.8 volt step-range gives you some desirable leeway in customizing a replacement circuit for your own particular linear amp. Now, by simply adding or subtracting diodes from the string, you can adjust the zero-signal anode current for your particular amp and tube combination parameters (guided by what the tube manufacturer recommends as the ideal idling current for that particular tube type). That's something you can't do using a fixed-voltage-power zener. Here's a quick example:

"Seven silicon diodes will provide a stable cathode bias of 5.6 volts (7 times .8 volts), 8 diodes would give 6.4 volts, 9 would yield 7.2 volts, and 10 silicon diodes would provide an even 8 volts.

"You can make up a small perf board layout for the diodes, say 10 diodes in all, then, with just a wire jumper, bridge out the ones that aren't needed, in order to arrive at the target anode-current 'idle' figure that you're seeking. If a new tube (or set of tubes) later on changes this figure significantly, you can readjust the idle current by simply moving the jumper.

"And don't forget, we're utilizing the 'forward voltage drop' of the silicon diodes—as opposed to the 'reverse voltage drop' in the case of the zener we replaced—so that the banded cathode end of this new stack will go to the point where the anode end went before, that is, just exactly opposite of the way the zener was wired into the circuit. You can use virtually any PIV rating for the diodes, since the voltage at the cathode is very low. The current rating of each diode in the string, however, should safely exceed the maximum expected cathode current, up to 3 amps maximum. Here's a final advantage: If you should happen to be the unfortunate victim of another high-energy parasitic pulse, it's a relatively simple matter to replace the diode or diodes that may have suffered the brunt of it ... and again, with a whole lot less cash outlay!"

We end this month's column after another of Rich's worthwhile ideas. Watch for many more in the months to come. If your idea isn't in here, why not? Everyone has run into interesting problems and found their own unique solutions to those problems. If you'd like to share yours with other readers, send them to me at the address above and I'll let you know promptly whether it will be used or not, and roughly when. The column is prepared a few months before the time that you read it because of magazine layout and printing considerations, so don't expect to see it next month, but chances are good that it will be used in a near-future issue. So click on the word processor program icon in your computer, and write a few lines about your favorite tip, technique or shortcut ... don't forget!

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Please send all correspondence relating to this column to *73* Ham To Ham column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

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Above & Beyond

VHF and Above Operation

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Adjuncts and other paraphernalia

This month's topic is adjuncts and paraphernalia that can be added to your equipment, making microwave operation easier with Wide Band FM (WBFM). Just having a transmitter and receiver rolled into a single neat package doesn't guarantee you'll make successful contacts. A few other ingredients are necessary, especially for those with the simplest equipment. By "simplest equipment" I mean the burglar alarm type of Gunn diode oscillator and detector arrangements, not the highly coveted Microwave Associates varactor-tuned Gunnplexers™.

The simple Gunn diode cavity devices are frequency dependent and must be adjusted to a set frequency in the amateur portion of the 10 GHz band. The units are aligned with an absorption type wavemeter before operation. Once frequency is set they have a narrow window over which voltage can be varied on the Gunn oscillator to make fine frequency adjustments. These frequency adjustments can move the basic oscillator over a 3 or so MHz frequency range at best. Primary accuracy is essential and must be set properly with the wavemeter type of frequency meter.

The varactor-controlled units like the Microwave Associates' Gunnplexers are premium units and offer frequency agility over a 60 to 80 MHz frequency range. If one end of your circuit has one of these units, other hams will find you, even if you are off frequency, and still make contact. The biggest problem with the burglar alarm type of Gunn oscillator is that you have to monitor the voltage tune pot for frequency disparities. If you like to tinker, read on; if you want to have an excellent unit, purchase the M/A unit. You decide what's best for *you*.

A nice addition to the operating unit is a wavemeter, coupled to an RF power meter amplifier, to increase the sensitivity of the wavemeter. Another test fixture is the twiddle tone generator. This device puts a distinctive tone on your transmitter through the audio amplifier modulator circuit, allowing weak signals a little better detection ratio when you are hunting for them in the noise. Other useful items are some good grid-square map locations of other stations, an ordinary compass, and other similar aids to help you aim a microwave signal towards a distant station accurately.

Each time you eliminate or reduce uncertainty in the microwave arena, your chances for a successful contact improve. The list of basic uncertainty items includes Gunn frequency accuracy, 30 or 88 MHz IF offset properly set, system sensitivity, and accurate compass bearings to the distant station. These are the main wobbles in the basic system and need to be addressed using some test equipment, plain old experimentation, and technical improvements.

The Gunn diode oscillator frequency can be set with a cavity wavemeter covering the 10 GHz frequency ranges. Rotate the drum dial, which changes the internal size of the cavity chamber (coupled to a section of waveguide). At various increments, the drum's outer surface is calibrated in frequency, reflecting the different cavity sizes as it's rotated. The cavity is a very high "Q" circuit and samples RF power going through the cavity's waveguide section. You will need some form of RF detector to observe relative RF power. Then notice the RF power level, spin the cavity, and when a slight dip is observed, this is your frequency. The cavity is absorbing some power when it is adjusted to your frequency; this mode is referred to as a "suck out" or "absorption" type of wavemeter.

The dip in power is sharp, and it's a slight dip, so adjust the wavemeter slowly for best accuracy. The meter amplifier is coupled to a detector on the waveguide output, allowing greater sensitivity to sample measurements being taken rather than direct connections to your system. A small horn antenna should be used on the input to the wavemeter, completing the package for the frequency meter and its wavemeter. See **Fig. 1** for the block diagram of how to connect these component parts for the monitor antenna, wavemeter/detector, and meter amplifier.

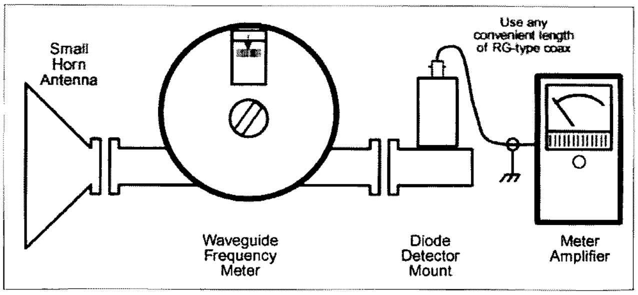


Fig. 1. Waveguide test antenna, wavemeter and meter amplifier. This setup is used to determine RF frequency, using a small horn antenna and a variable commercial waveguide frequency meter. RF is sampled with a detector and displayed on an amplified meter for sensitive meter indications.

This one simple meter amplifier, coupled to a commercial absorption wavemeter, is essential in locating and telling you what frequency you are operating on. The wavemeter coupled with a meter amplifier, affording higher sensitivity, allows you to make frequency measurements close to your antenna vs. a direct connection.

The circuit for this amplifier is a single voltage supply (9-volt) portable radio battery powering a single CA-3130 op-amp amplifier. Do not use a substitute for

***Photo A.** WB6IGP operating 10 GHz WBFM on top of Mt. Soledad in San Diego. The spike on top of the dish is a 2 meter ground plane antenna for 10 GHz contact coordination.*

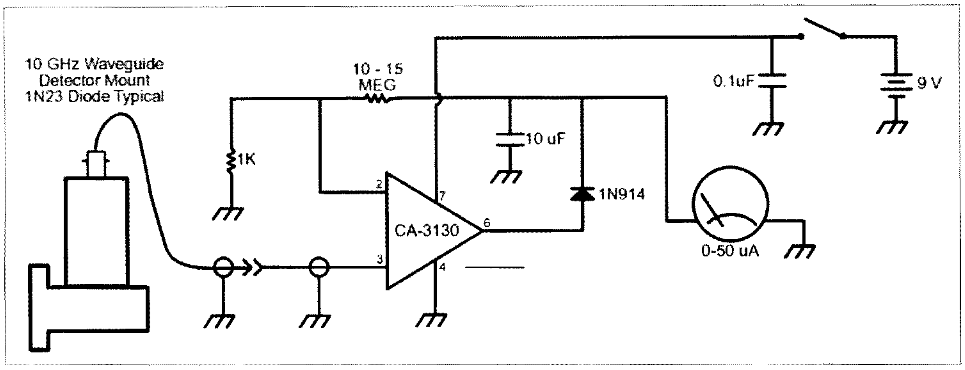


Fig. 2. Schematic diagram for the wavemeter amplifier that is connected to the microwave waveguide detector. This circuit operates on a single 9-volt transistor radio battery for simplicity.

the CA-3130, as others will not work in this circuit. The CA-3130 is made to work with a single supply voltage and ground, unlike other op amps. See **Fig. 2** for the necessary schematic diagram.

> ***"It's still a sensitivity game, and this little tool is so simple to build that all you need is a waveguide detector mount, to which a small TTL 5-volt oscillator is capacitor-coupled."***

System sensitivity improvements

A simple circuit using a simple Gunn transceiver is a circuit called the "Boomerang." What it does is essentially just what its name implies; weak but detectable signals are reflected back to the source. It is not a frequency calibrator for microwave as its operation is dependent on whatever frequency IF system you use, but it does receive your transmit RF and mix it with a fixed crystal oscillator equal in frequency to your system's IF frequency. It then re-radiates this new mix product which is detectable in your receiver. This signal can be used to test system sensitivity by moving the boomerang farther away from your transceiver as system sensitivity increases.

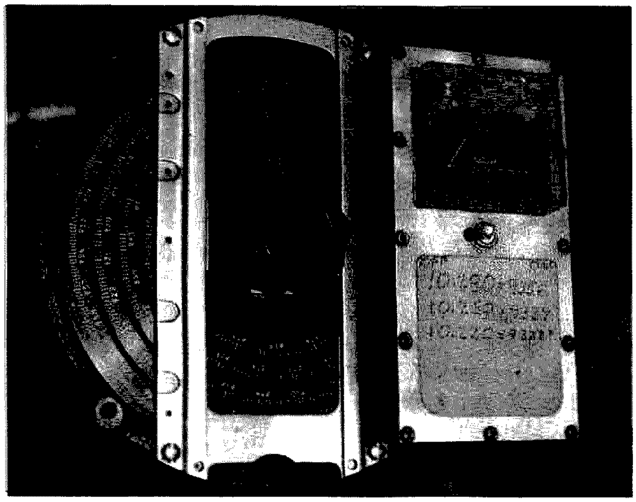


***Photo B.** Surplus waveguide frequency wavemeter with amplifier and meter indicator attached. The unit had calibration readings noted for 10.220, 10.250, and 10.280 GHz. It was very useful when using simple Solfan or burglar alarm type Gunn oscillators for WBFM.*

Add a dish or other directional antenna to your system, and the same Boomerang can be used to adjust antenna feeds for best gain. It also can be used to test angles of your dish or other antennas. It's still a sensitivity game, and this little tool is so simple to build that all you need is a waveguide detector mount, to which a small TTL 5-volt oscillator is capacitor-coupled. Any oscillator operating at your IF frequency will work here, be it a ready-to-go TTL type or a home-brewed device. In either case, it is coupled to the detector mount and antenna attached to the Boomerang.

If your IF system is 30 MHz, use a 30 MHz crystal and set it to the same frequency at which your 30 MHz IF is set. If you are using the 88 MHz FM radio as an IF amplifier, select a crystal to match the IF frequency you select (i.e. 88.123 MHz). That's all there is to it. Power in the oscillator is not important—just a single transistor oscillator circuit will do. See **Fig. 3** for circuit information.

Grid square program

Our microwave group has a grid square program written in BASIC that should run on most any PC. It will give you compass direction to and from distant stations, once data with grid square or latitude and longitude information is input. The program is a bonanza, eliminating guesswork with map coordinates converted to grid squares, which is often needed for contest operation. The program runs in the Chevy manual mode. For the latest input to this program for Caddy drivers, GPS (Global Positioning Satellites) are used; the exact-position data is loaded into the computer's RS-232 input port and loaded into a modified BASIC program. Additionally, a very small interface terminal has been built by Jay Goldberg, to take the data directly from the GPS receiver and display universal time and latitude/longitude data to a small 20-character plasma display. This display could be mounted on the dash of a car for portable pinpoint accuracy on location.

Well, there you have most of the insights into microwave operation, and some options on how to set up a small inexpensive station. These trails, laid out for you, were exactly the same beginning steps that many of us took, myself included, in years past. Yes, we still have our WBFM equipment, but we have grown into much more complex and costly equipment in the pursuit for better devices and systems. I strongly urge you to try WBFM as a beginning test vehicle; it's inexpensive and will give you some experience in the microwave realm.

10 GHz—the next generation

When you're ready for improved circuitry, high stability systems, GaAsFET amplifiers, and synthesizer frequency control to 100 Hz at 10 GHz, let me know. We have kits available, derived from commercial material, that require modification of a microstripline PC board. After modification, these units assemble into a very high-quality SSB linear system with 1 watt of output power and a receive noise figure of 1.5 dB on 10 GHz for a full-figured configuration. The basic system is contained on a single PC board (4-1/2" x 5-1/2" x 1/2" high). All circuitry is on the board, including mixers for 10 GHz. Prices start at $100 for a basic kit, plus shipping and CA tax (for CA residents only), and are available from the author, me, at the address above.

Other microwave systems have been constructed using components that were found in the

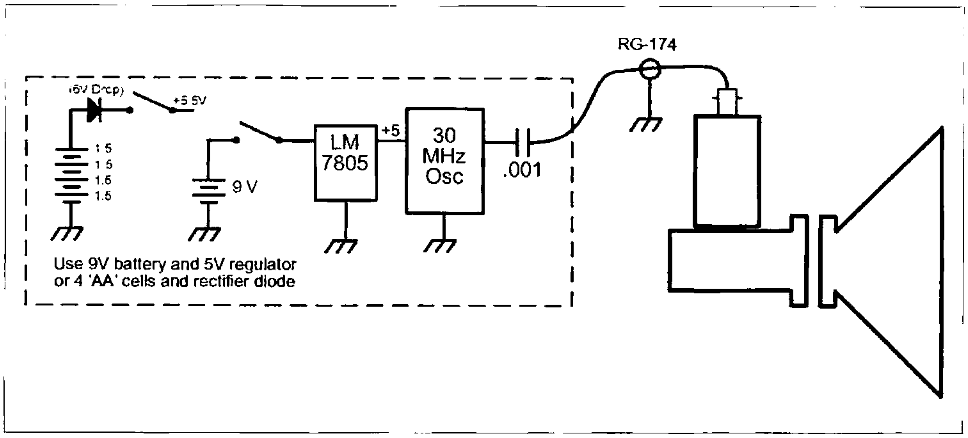


Fig. 3. The Boomerang, or microwave reflection antenna, is a slick test accessory that helps you make relative tests to improve your system's sensitivity. It can also be used to test feed position and microwave dish aiming characteristics. The essential component is the 30 MHz TTL oscillator and a waveguide detector mount. If other IF frequencies are being used besides 30 MHz, change the crystal frequency accordingly.

surplus market. It's amazing what can be lashed together to make a microwave converter. As an example, the above kit for 10 GHz sounds quite hi-tech. Well, for frequencies lower than 10 GHz, the gizmos needed are not as fancy or as expensive. As frequency decreases further, more and more components can be brought into play to construct a simple microwave converter.

What microwave piece parts do you look for when trying to gather material for lower frequency bands? As in any system, you need a mixer—that is a *must*. After that, you need a local oscillator to convert your IF, which could be a low-power handie-talkie on 2 meters or 450 MHz. Couple it to an amplifier with a coaxial relay to switch the circuit and you have the basic ingredients needed: mixer, local oscillator, amplifier, and relay switching.

Why venture into other amateur frequencies? In our case it started with a challenge from Kerry N6IZW: Attempt to construct a simple system for the three lower frequency microwave bands. The plan was to try and get something up and running for each of the 2304, 3456, and 5760 MHz frequency bands, one a month, for demonstration at our club/group meeting.

The requirements were not stringent, and might be nothing more than a local oscillator and mixer for each frequency in question. The intent was to promote microwave interest, along with a challenge to see what our group's members were crazy enough to assemble. The challenge was like trying to line up volunteers for a cardboard boat race. Somewhat practical, but all for fun!

If you're wondering how we achieved such a frequency-stable synthesizer, it's the main reference clock (10 MHz accurate to .01 PPM) that locks up the main synthesizer to minimize frequency errors. As I said, new toys and devices are only separated by the cost of the toys—I hesitate to mention cost as a separator between modes of operation and equipment for microwave. WBFM, as you can see, required very simple devices to make it tick. This system, on the other hand, requires an increased level of both technical skill and test equipment to make system modifications and see just what is going on. My workbench includes spectrum analyzers and microwave power meters and signal generators and sweep oscillators accurate to 18 GHz. If you venture into this realm, hopefully there will be some test equipment available to you on an individual or club basis to test your projects.

While all this equipment is not necessary, it gives you a glimpse of the increased test equipment you must have in order to modify microwave stripline circuit elements. You need some basic generators and power meters, along with technical skills, to work with these small microwave circuits—microsurgery is not for everyone and at times it's not for me. I have made my share of big blunders, primarily due to speed vs. eyesight problems with the chip component circuitry. I was able to overcome speed by just going slower and being more careful. As to the eyesight problem, I've corrected that by purchasing a dual eyepiece hood magnifier to back up my reading glasses. It really filled the bill for seeing fine details on the printed circuit boards' chip circuitry that are .050 inch square. Soldering miniature components like this can be quite demanding, trying to make a neat, orderly connection and do a good soldering job at the same time. With the magnifying hood it was not a problem.

So much for this month. Next month, I will report on the San Diego Microwave Group's progress on our quest—our energetic construction program. I will have data on the 2304 and 3456 MHz rigs that were constructed. Do not expect fancy frills or high power: these are for fun. I can't wait to see what rigs are constructed. 73 Chuck WB6IGP clhough@aol.com.

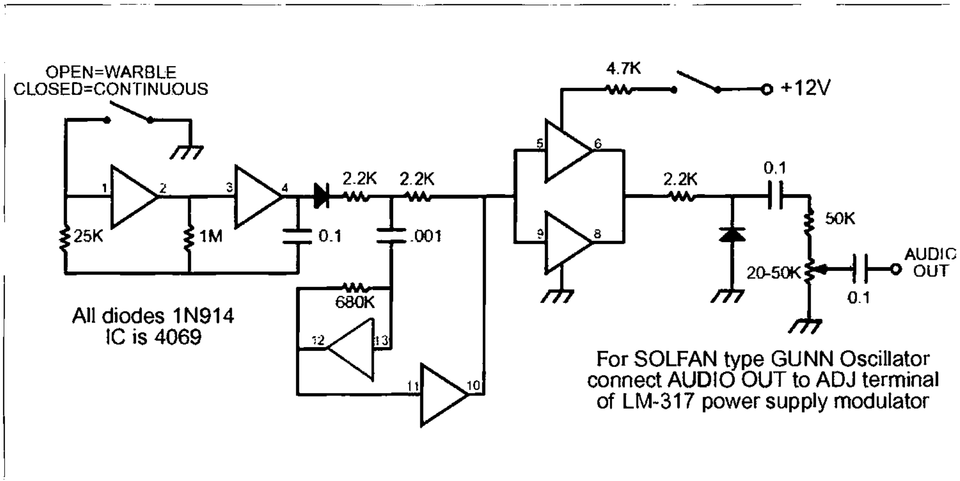


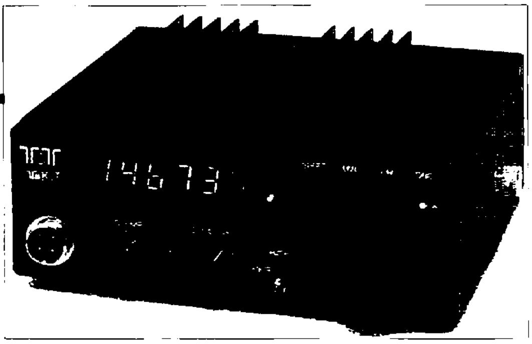
Fig. 4. The schematic of the twiddle tone generator. This unit produces a distinctive tone that skips between two different frequencies, producing a tone pattern, allowing an easier search for new units to communicate with. It's our equivalent of a simple beacon-like tone identification accessory.

73 Review

Number 56 on your Feedback card

The Ten-Tec 2m Transceiver Kit

Have a ball building this great little $200 rig.



Jeff Gold AC4HF
1751 Dry Creek Road
Cookeville TN 38501

This time I'm really excited! With all the new no-code Techs, the most common ham buy these days is a 2 meter transceiver. Since I have always enjoyed operating radios that I have built myself, the Ten-Tec T-Kit #1220 looked like just the ticket. Besides, while building, I am also learning how the equipment works, so I'm more likely to be able to repair it.

Ten-Tec is filling the void Heathkit left when they quit. They obviously put a lot of work into designing a microprocessor-controlled 2 meter rig that can be assembled, adjusted and maintained by hams with average building and soldering skills.

The rig has front-panel tuning in 5 kHz or 2.5 kHz steps. There is a six-digit sunlight-filtered LED frequency display and 15 programmable memories. There is also provision for five non-standard offsets and a built-in CTCSS tone generator. The transmit-receive switching is done with diodes. The rig uses a standard five-pin DIN packet connector and circuitry. There is a built-in speaker, as well as an external speaker jack. You can switch between two power levels from the front panel. Without the optional 1222 amplifier kit you will get about 1 or 5 watts, and with the amplifier, it's 5 or 30 watts.

"When you are done, this unit looks like a small commercial mobile rig, not like a kit you have built."

Ten-Tec has you build the rig in stages. After you finish each stage you test and align it. They provide a blow-up of the part of the circuit you are working on with a schematic for that one section. Thus, if you do make an error, you know that everything that you have done before has checked out and you have only one small section to check for the problem. I was very careful, but when I finished the receiver and audio section, it didn't work. I found I had put a wrong value resistor in two places. I enjoyed their approach since I didn't have to wait until I finished the whole project to know that the sections were working.

The first section you build is the display driver and microprocessor circuits. When you are done, you get to see it light up. Next, you build the voltage-controlled oscillator (VCO) and phase-locked loop (PLL) circuits. Then you align the VCO using a standard voltmeter to adjust a test point for a given voltage. Then you need only check for a voltage change as you tune from one end of the band to the other. There is an optional test if you have some way of generating a 10.7 MHz signal to verify the receiver operation. The third section is the FM receiver and audio section, where you get to hook up the speaker and test the audio and squelch.

Next you build the receiver RF amplifier and mixer. Then you adjust several coils for maximum voltage and one transformer for best voice quality. You now have a working receiver, so you can start listening to the local repeaters. The memories are now functional, as are the repeater offsets.

The fifth section has you building the transmit audio, push-to-talk (PTT) and frequency modulation of the VCO. When you complete this you can transmit. Boy, is that a good feeling! Now you are close to having a working transceiver.

Next you build the CTCSS tone and packet circuits; there are no alignments or tests for this section. You proceed to the transmit RF section and then to the final assembly and testing. At this point, you can either choose to have an operational 5 watt transceiver or add the optional amplifier. Either way, Ten-Tec suggests that you test out the transceiver at the lower power before installing the amplifier. If you know you are going to install the amplifier, you'll need to substitute two heavier duty diodes while building the main unit. This will save some desoldering later.

I tuned the rig to one of the local 2 meter repeaters and gave a call. The chap who came back to me reported that the rig had a good natural-sounding voice quality and I was into the repeater full quieting, even with the rig on the 1 watt power setting. He reported no difference in either the audio or my signal quality on low power. I still get excited when a new piece of gear I've built works right.

The kit

This is a high quality kit in every way. The printed circuit board is plated through, solder-masked, and nicely silk-screened. The plated-through part really helps in making the connections sturdier so that the assembled rig lasts longer.

The kit is complete, with all components, boards, hardware, and case. A microphone is included; however, it doesn't have a DTMF pad, so you need a separate pad to use an autopatch. Or you can use one of those "Pocket Tone Dialers" sold by Radio Shack™—a DTMF keypad that you place over your mike. It is designed to produce tones for systems (phone) that have no DTMF capability. Their least expensive one (43-145) is $17 and the next one up (43-146) with 33 memories lists for $25.

Most of the coils are pre-wound. Those that aren't are very simple to wind and there are clear instructions on how to do that. The case is very nice looking. When you are done, it looks like a small commercial mobile rig, not like a kit you have built.

I found the manual outstanding. It's very thorough, but doesn't include page after page of pointless details. The kit went together very easily for me. The few minor problems I had were my own fault. If you run into a problem while building the kit and call for help, you might very well discover that you're talking to the person who designed the rig.

> ***"This kit makes it possible for even a no-code Tech to have the fun of building a transceiver and the pride of operating something they've built."***

This kit makes it possible for even a no-code Tech to have the fun of building a transceiver and the pride of operating something they've built.

The completed transceiver works great! It's easy to program and use. Even without the optional amplifier, you should have no problem getting in full quieting to most local repeaters. I have had no trouble getting into any of the five local repeaters on low power without the optional amplifier. For more distant repeaters, you might want to go for the optional amplifier. If you build the amplifier later you add a very simple board onto a big heat sink, desolder two diodes from the main board, and put in a jumper. The s amplifier board fits on a heat sink which attaches to the back of the rig.

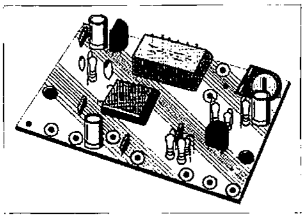
It doesn't take much of a power supply to run the rig. 13.5 VDC at 1A on low power and 5A on high power. The completed unit weighs only 2-1/2 pounds (and that's with the amplifier added), so you can even take it along on camping trips.

$195 for a kit of this quality is a real bargain. Who says amateur radio is an expensive hobby? I recommend the Ten-Tec T-Kit #1220 highly.

For more information contact Ten-Tec at 1185 Dolly Parton Parkway, Sevierville TN 37862-3710. Or call their information line at 423-453-7172.

Number 72 on your Feedback card

New Products

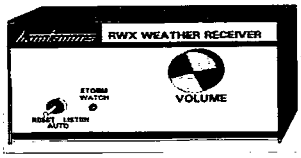


New CTCSS Encoder/Decoder Module

Hamtronics has a new version of their long-popular Subaudible Tone Encoder/Decoder module. The new TD-5 has several new features, including crystal control for precise tone accuracy and a convenient DIP switch for tone selection without test equipment.

The TD-5 will let you use your existing FM transceiver to access all your favorite closed repeaters. The thorough manual shows you all you need to know about encoding and switching and selecting tones, and helps you install the module in any transceiver. If you need a receiver decoder, the same TD-5 can be used to mute receive audio unless the proper tone is present on the signal. A convenient control line can be used to unmute the receiver manually to allow monitoring, and a high-pass filter gets rid of annoying tone buzz in the speaker audio.

And it's only $39—what a deal! That's the kit price, of course, but it's only $59 factory-wired and tested. For more details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535; call (716) 392-9430 or FAX (716) 392-9420. While you're at it, ask for their complete catalog, and please tell them where you saw this announcement.



Professional-Quality Weather Alert Receiver

The new RWX Receiver from Hamtronics, Inc., the leading supplier of narrow-band FM receiver and transmitter modules for hams, is just what you need for demanding applications. Airports, police and fire departments, CAP, rescue crews, broadcast stations, amateur repeaters, local emergency managers—anyone who needs up-to-date weather information and emergency warnings—can depend on the RWX Receiver. Because of its reasonable price, it's also handy for bikers, hikers, boaters, farmers, hunters...well, who *couldn't* sometimes use an automatic "Storm Watch" alert? That's only one of the RWX Receiver's many features.

The RWX Receiver is small enough for emergency or portable use, and can be powered by a 9-12V battery when needed. It's crystal-controlled for accuracy, and all seven channels are provided, including the new split channels.

For economy, get the PCB module in kit form for only $79. With Hamtronics' thorough instruction manual, you'll find it easy to build and align. You can also buy the kit with a cabinet, AC power supply, and built-in speaker for only $99. And if you decide to take the easier route, the unit is available factory-wired and tested with an attractive metal cabinet, speaker, and power supply, for $139.

For more details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535, or call (716) 392-9430. Ask for a data sheet on the new RWX Receiver. While you're at it, let them know where you read this announcement.

HamCall CD-ROM

Buckmaster's HamCall CD-ROM April 1996 edition is now available, from Buckmaster or your dealer. Get complete US and extensive international listings—over 1,290,000 callsigns, including clubs, military, and RACES listings, with more than 110,000 cross-references from old to new calls. You'll have all the data you need right there in front of you, and you can print lists and labels, edit records, even look at photos of many hams. Photos/QSLs appear automatically in Windows©, with the touch of a button in DOS. Your photo or QSL can appear in the next update, free! Find out more by contacting Buckmaster, 6196 Jefferson Highway, Mineral VA 23117; Phone (540) 894-5777 or (800) 282-5628; FAX (540) 894-9141; E-mail at info@buck.com.

Low-Cost Boom Microphone Headset Kit

The new Model TR-2000 is specifically designed for amateur radio applications, and features a noise-canceling electret microphone with a "tailored" frequency response. The flexible microphone boom is spring-loaded to provide a mechanical memory for the user's adjustment. Received signals through the moving-coil ear speakers are crystal clear. The large plush earmuffs aren't just comfortable; they add to the noise-canceling feature, allowing good performance even under high-background noise conditions.

The Model TR-2000 is compatible with the majority of contemporary radios—fixed station, mobile, hand-held, HF, VHF, and UHF, as well as many vintage rigs.

The Model TR-2000 is an easy-to-assemble kit with step-by-step instructions for $44.95, or assembled and tested (without connectors) for $64.95. Both options are available with a 30-day, money-back guarantee from Warren Gregoire & Associates, 229 El Pueblo Place, Clayton CA 94517. For additional information, call (800) 634-0094 or (510) 673-9393.

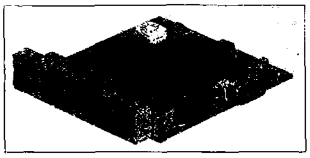
CABLE X-PERTS, INC.'s New Catalog Is Invaluable!

If you're replacing or adding cable of any kind at your station, or just getting started, you'll find this new catalog essential. It's a complete listing of cables, technical information, prices, and now detailed pictures and connector installation instructions. All this, and more, for a business-size SASE sent to: CABLE X-PERTS, INC., 416 Diens Dr., Wheeling IL 60090.

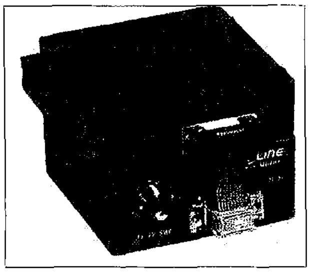
RF Applications Digital Wattmeter

A *digital* wattmeter? The P-2000A is a digitally-driven analog meter that indicates peak RF power and VSWR. This little $299 baby automatically selects the 200- or 2000-watt range for you. It has an SWR alarm which you can set to trigger when it goes over a certain SWR. Write RF Applications, 9310 Little Mountain Rd., Mentor OH 44060, or call 800-423-7252 for even more reasons to buy it.

Alchemy Today by Chris Illert. Subtitled: A beginner's guide to Hadronic circuit diagrams and secrets of cold nuclear fusion. This large 172-page archival quality (very heavy paper) book is a lavishly illustrated introduction to the latest concepts in atomic physics. Well, atoms are made up of electrons, protons, and neutrons. And they're made up of quarks. And quarks are made up of omegons. And what are omegons made of? Strings of Green Energy Balls, as originally describedby Bessant and Leadbeater in 1895. Aha, so what is "energy?" Never mind, just get the book and catch up with the weird places theoretical physics has gone in the last few years. Warning: this book is not easy going. However, if you're interested in learning about how cold fusion works, this book is a fine primer. $60.00. From Radio Bookshop. (Order form on page 88.)



Optional Module for Skyline-RTU



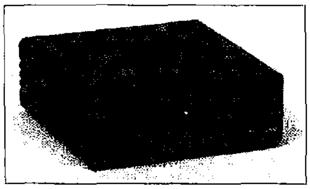
Skyline-RTU

Skyline-RTU with a No-Cost Repeater Option

Does it get any better than this? RF Neulink is now shipping its Skyline-RTUs with a no-cost repeater option; the repeater function is implemented via the serial port. Each RTU is a fully integrated subsystem that includes a UHF transceiver, RS-232 modem interface, and a digital/analog I/O board. The standard device provides for eight optoisolated digital inputs/outputs, and two analog-to-digital converter terminals. The I/O modules are stackable up to eight units, providing a combination of up to 64 digital I/O and 16 A/D terminals. Optional RTU modules are available with eight channels in and out, and four channel relay output ports.

The radio modem platform is the Neulink 9600, a high-speed, 9.6 Kbps, 2 watt transceiver modem. Up to 64 RF channels can be programmed into internal memory. Additional features are 16-bit CRC error detection, RTS/CTS, XON/XOFF, or no flow control. With its 65,000 unique ID codes, this synthesized UHF modem can be configured for point-to-point and point-to-multipoint networks.

For more information, contact RF Industries, Neulink Division, 7610 Miramar Rd., San Diego CA 92126; phone (619) 549-6340.



Versatile New Telephone Interconnect

Communications Electronics Specialties has released the first in a new series of telephone interconnect devices that will allow land mobile radio users easy access to the telephone network. The new simplex and semi-duplex 4700VP can be easily installed into nearly every repeater/transceiver on the market; it has an automatic setup feature and can be programmed locally or over the air.

The 4700VP is the lowest cost, smallest size unit on the market, but it's loaded with features like 25 speed-dial locations, 10-digit connect/disconnect code, pulse or tone dial, lightning protection, full-feature toll restriction with inclusion and exclusion numbers, built-in audio path and last number redial. For more information, telephone CES at (407) 679-9440, FAX them at (407) 679-8110, or write to: 925-122 S. Semoran Blvd., Winter Park FL 32792.

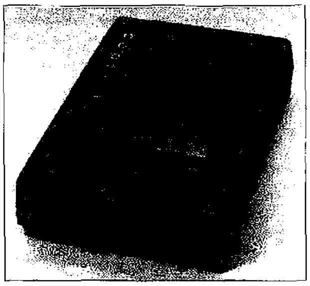
Final Quantum Revelation by Kiril Chukanov. Subtitled: General theory of world organization. This 400 page book is also lavishly illustrated. It is also tough going at times (lots of equations), but it covers an amazing range of topics. Ball lightning as a potential source of power, cold fusion power, etc. Chukanov got his information via a series of revelations from a supermind, but you'll see that he's backed up his theories with good solid lab work. He covers the fundamental laws, elementary particles, chemical elements, quantum boundaries of the world, the solar system, the galaxy. $35.00 from Radio Bookshop. (Order form on page 88.)

QSL Contest

Did you buy your QSL off a rack, or did you put some thought and creativity into it? If you think you have a winner, send it in and let us have a look at it. Who knows, it might make the cover. Well, maybe page 85 or so. Or maybe Wayne's wastebasket. If it's declared a winner, you'll get a CD of your choice of any of 26 kinds of music, as listed in Wayne's November editorial. You'll also see it in 73!

Send it to:

QSLContest,
73 Magazine,
70 N202,
Peterborough NH 03458-1107
Bribery? You Bet!



New Compact Voice Logging Recorders

Whenever it's important to verify every detail—emergency calls, contesting, meetings, or the like—Omnicron recorders provide assurance. Slow-speed recording allows up to 16 hours of talk time on a standard audio cassette, and their time track option documents time and date on a separate channel throughout all recordings. VLR recorders also permit monitoring during recording, making them ideal for those of us who are trying to do two (or more) things at once!

Additional standard features include voice-activated recording, alarms to prevent operator error, a 2X ANSI tape position counter, dual headphone jacks, and advanced automatic record level circuitry. Priced from $340, VLR recorders are available with a complete line of accessories, including the TCC-14 time/date source.

For more information, contact Bill Jones at Omnicron Electronics, 581 Liberty Highway, Putnam CT 06260; telephone (860) 928-0377; FAX (860) 928-6477.

PowerAlert™ Software Now On CD-ROM

Tripp Lite's PowerAlert Plus network power management software is now available on CD-ROM for easy installation. All versions of PowerAlert Plus include cabling and come on a single CD-ROM covering Novell, Windows 95/Windows NT, OS/2, UNIX, HP-UX, and HP Openview operating systems. The CD-ROM also includes Tripp Lite's Novell SNMP agent that allows SNMP management without external adapters.

PowerAlert Plus measures and displays power parameters such as maximum and minimum line input voltage and line frequency from any workstation or server, and logs all the information. It also provides comprehensive records of power disturbances, pools alarms, and stores alarm setpoints, enabling tracking to the problem's source. PowerAlert Plus also monitors and graphically displays battery power, percent of UPS load and internal UPS temperature, allowing precise knowledge of conditions and alerting the network manager to potential problems before they occur.

PowerAlert Plus is the only power management software available on CD-ROM covering so many systems on a single disk. It's available separately for $89 or bundled with Tripp Lite's SmartPro UPS systems. For more information, call (312) 755-5401; FAX (312) 644-6505; E-mail: info%tripplite@mcimail.com; or at web site http://tripplite.com.

CARR'S CORNER

Analog-to-Digital (A/D) Converters

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041

Some things you oughta have

When we think of ham radio stuff we normally think of a shiny new SSB transceiver with digital readout, digital signal processing, a pan adapter oscilloscope to check for gaps in the band where one might set down and call "CQ," all of which costs more than I paid for my first new car (of course, it's relative—I paid about the same for that car as my father paid for his first house). There are, however, a number of things that are handy to have around the ham shack. Let's take a look at a few of them.

Dummy loads

The dummy load, or artificial aerial as it is called in the UK, is a resistor used to simulate an antenna when adjusting a transmitter or other radio apparatus. These devices consist of a noninductive 50-ohm resistor inside a shielded enclosure.

The dummy load offers a couple of benefits over regular antennas. First, it is a nearly constant impedance over the entire frequency range, and, second, it does not present any appreciable reactance. Third, and perhaps most important, the dummy load provides the ability to conduct tests off the air where you won't cause TVI, BCI, or interference to other users of the test frequency that you select. Besides, it is illegal and just plain rude to radiate when you don't have to!

One use for dummy loads is to adjust antenna tuners. You can connect the dummy load to the antenna output of the tuner, and then adjust the controls for best VSWR at a number of frequencies. By recording the knob settings, you can "rough in" the antenna tuner when changing frequency.

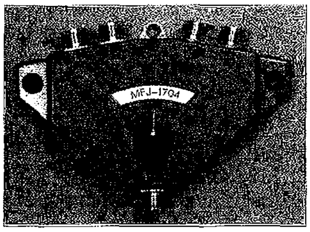


Photo A. *Coaxial switch.*

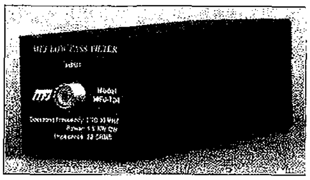


Photo B. *Low-pass filter*

Coaxial switches

A coaxial switch (**Photo A**) is used to allow a receiver or ham radio set to use any of several antennas (up to 16-port models are available, but this one is a four-port model). The common connector is for the receiver or transmitter, while the antennas and/or dummy loads are connected to the "A," "B," "D," and "E" ports, respectively; the "C" port is for the coax line to the rig. Alternatively, one can turn the switch around backwards (it's bi-directional, after all), and use the same antenna on two different receivers or transmitters.

The use of the coaxial switch in antenna measurement is in comparing the antenna being tested with either another antenna or a dummy load. The kind of off-the-air checks that amateurs can make are notoriously inaccurate, but can be made a lot more useful by making comparisons with known antennas. For example, a friend of mine, the late Johnnie H. Thorne K4NFU/5, had an antenna farm in Texas (and it did seem that he grew antennas, judging from the number he had). He kept a standard dipole, optimally installed and cut for 20 meters, and made all of his test designs for the same frequency. He would compare new designs to the dipole by switching back and forth while monitoring the signal strength on the receiver's S-meter. He could also compare two different antennas by comparing them against each other or against the dipole. Not perfect, and anyone with a professional antenna range would sneer, but it worked for ham purposes.

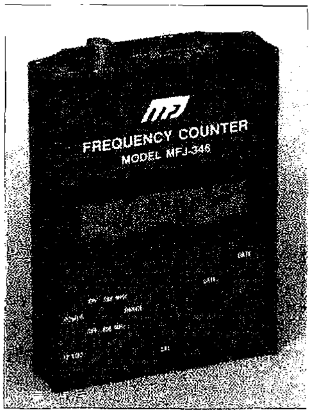


Photo C. *Digital frequency counter.*

Low-pass filter

A low-pass filter (**Photo B**) is a frequency selective device that passes frequencies below the cut-off frequency, and attenuates frequencies above that point. So why do we need a low-pass filter? Because all transmitters produce harmonics, i.e., signal at frequencies that are integer multiples of the fundamental frequencies (14 MHz is the second harmonic of 7 MHz, while 21 MHz is its third harmonic, etc.). Although there are legal specifications of how little harmonic energy you are allowed to produce, and we would like to radiate zero power at the harmonic, all real transmitters produce some harmonics. The problem gets worse when the antenna is resonant on the harmonic or the transmitter is either improperly adjusted or defective.

The main purpose of the low-pass filter is to prevent harmonic energy from HF ham transmitters from clobbering television reception. The typical ham low-pass filter has a cutoff frequency at some point above the 10 meter ham band, but below TV channel 2. If a harmonic is produced by the transmitter, then it will be attenuated by the low-pass filter before it does any damage.

Digital frequency counter

At one time, digital frequency counters (DFC) were terribly expensive. Even "cheap" models cost about the same as new cars of that era, and they were heavy, as well as power hogs. Those DFCs were really open only to professionals and that top elite of rich hams. The rest of us used a receiver and crystal calibrator to measure frequency, more or less (although I've seen some pretty good results using cheapo equipment during the old ARRL Frequency Measurement Tests).

Today, the situation is different. While the best DFCs are still costly, there are a number of ham-grade instruments on the market (**Photo C**) that are very reasonably priced, and will allow you to measure frequency accurately enough for most ham uses. These battery-powered devices make the use of the DFC a game for all.

Doing DC

One of the aggravating things about my ham shack, as well as my computer desk, is the ugly wall-warts hanging out of every available 120 VAC outlet. Every accessory that you buy these days seems to be powered by a wall-wart transformer, and there just simply isn't space for all those power modules. **Photo D** shows a DC power strip. A single DC power supply is input to one end, then up to seven devices can be plugged into the DC outlets. A DC voltmeter on the strip reads the value of the applied voltage.

Connections ...

I can be reached via snail mail at the address above, or via Internet E-mail at carrjj@aol.com.

Photos for this column were supplied by MFJ Enterprises, Inc., P.O. Box 494, Mississippi State, MS 39762.

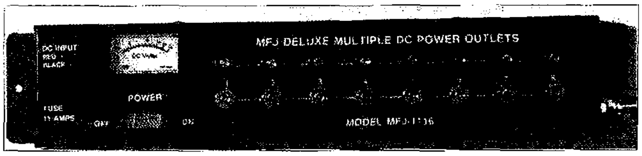


Photo D. *DC outlet strip.*

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

A key part of every satellite station is the antenna system. While small, simple antennas are great for experiments and portable use, they make most contacts via satellite difficult and less enjoyable. The end result is fewer contacts, less fun, and eventually disinterest in this exciting facet of amateur radio.

Most newcomers to OSCAR (Orbiting Satellite Carrying Amateur Radio) start on the analog LEO (Low Earth Orbit) hamsats, like RS-10 and RS-12, using simple antennas. Successful enthusiasts study the deficiencies of their systems and make corrections. With some experience, they eventually go on the digital satellites like KITSAT-OSCAR-23 and 25, and the high-orbit hamsats like AMSAT-OSCAR-10 and 13. The others go back to HF and local repeaters.

Successful LEO antennas

Most ham stations already have sufficient antennas to get started with LEO satellite work. Almost any antenna cut for 10 meters will receive RS-10. A dipole or inverted-V with a reasonable coax run and a sensitive receiver will do the job. For many this will be their final receive configuration, providing effective results for hundreds or even thousands of satisfying contacts.

Improvements require experimentation and will be location-dependent. Antennas that work include horizontal loops, verticals, turnstiles, eggbeaters and yagis. Due to the different radiation patterns of these antennas, some perform better than others during a given satellite pass. The vertical and the yagi may do well for DX contacts when the satellite is on the horizon, while the dipole or turnstile will have better reception when the satellite is overhead. One option is to have two or three different 10 meter antennas hooked to a coax switch in the shack. When reception on one antenna is bad, try a different one.

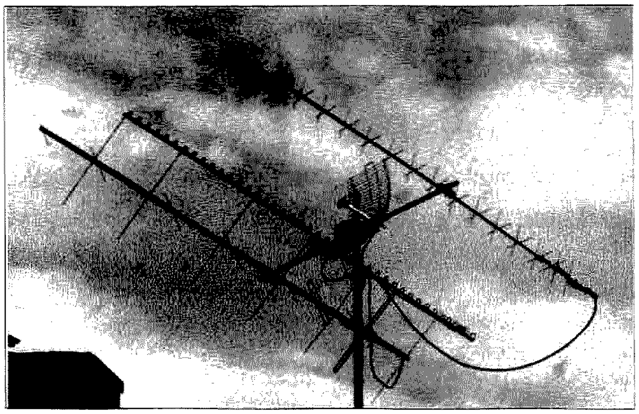


Photo B. An array of antennas for A-O-10 and 13 work at WA5ZIB includes (from left to right) a KLM 2M-14C for 2 meters, a Down East 45-element loop yagi for 23 cm, a Bob Myers dish for 23 cm and a Hy-Gain 215SAT for 70 cm, all on a nine-foot Fiberglas™ boom.

"Getting a 2 meter signal up to RS-10 is almost as easy as receiving signals from the satellite."

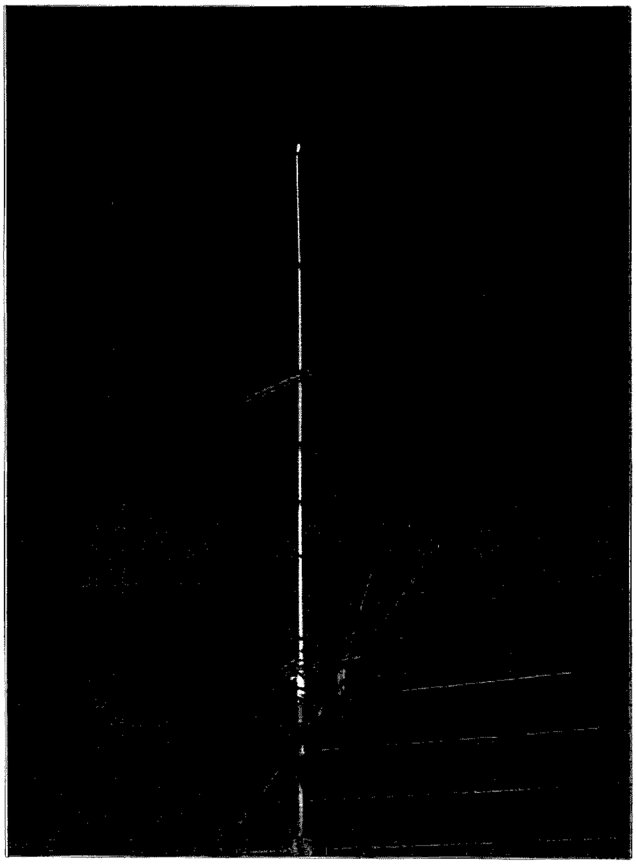


Photo A. A vertical mounted above the TV antenna does a great job for the RS-10 uplink on 2 meters.

Getting a 2 meter signal up to RS-10 is almost as easy as receiving signals from the satellite. Almost any omnidirectional vertical antenna in the clear will work with a 25-watt transmitter. While there are several commercial antennas to choose from, others, like ground planes and J-poles, are easy to build. For the 15 meter uplink of RS-12, a dipole with a 25- to 100-watt transmitter will do the job.

Antennas for the high-orbit hamsats

While most LEO satellites have altitudes of 1,000 miles or less, the high-orbit DX satellites like A-O-10 and 13 have apogees or high points out to 24,000 miles. The signals from these satellites are much weaker. Better antennas are needed to make reliable contacts.

The current high-orbit satellites use frequencies in the 2 meter, 70 cm and 13 cm bands. After the launch of Phase 3-D, later this year or early next year, we will have a satellite spanning ham bands from HF up through 24 GHz. The bands covered by A-O-10 and 13 will be very popular on P3D, and provide future P3D users with an opportunity to get ready for the new satellite by getting systems running now. Signals from P3D are expected to be at least 8 dB better than the signals from A-O-13, but not for all passes. Setting up an antenna system for reliable activity through the current satellites will insure great operation through P3D.

VHF and UHF satellite antennas don't need to be up high, they just need to "see" the sky. It's best to have an unobstructed view of the horizon in all directions. Trees and buildings attenuate both received and transmitted signals. Commonly used antennas for 2 meters and 70 cm are circularly-polarized commercially-built crossed yagis. Manufacturers include Hy-Gain, M-Squared, KLM, Tonna and others. The first four brands are the easiest to find.

One package includes a 20-element 2 meter crossed yagi, a 16-element 70 cm crossed yagi, and a mounting boom with mounting plate suitable for use with the

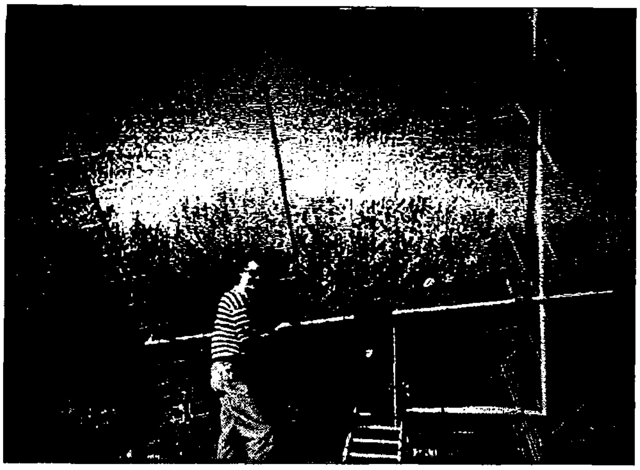


Photo C. Bruce KK5DO doing some maintenance on his rotator system. The antennas include an M-Squared 2MCP22 for 2 meters and a pair of 436CP30s for 70 cm.

Alliance U100 rotor (used for elevation control). It does not come with polarization switching, but it is the least expensive. The cable harness typically is set for RHCP (right-hand circular polarization) to conform with most satellites. The individual antennas, cross boom and mounting plate can be purchased separately, if necessary. A polarity switcher is available for the 70 cm antenna, and a 10-element 2 meter crossed yagi is an alternative for those with space constraints. The smaller antenna exhibits less gain.

The OSCAR Link antenna system from Hy-Gain offers advantages over other systems, but costs a little more. It includes a 16-element 2 meter crossed yagi, a 30-element 70 cm crossed yagi and a heavy-walled Fiberglas™ cross boom. The hardware is stainless steel with ultraviolet stabilized plastic insulators. Many other items have been carefully engineered, including polarization switching relays rated at 200 watts. For a cost-effective system with excellent performance, this antenna array is the best choice.

A newer company called M-Squared sells several types of satellite antennas. The most popular models for effective communications through A-O-10 and 13 are the 2MCP14 and 436CP30, for 2 meters and 70 cm respectively. The 2MCP14 has 14 elements and a 10-foot boom, and matches well with the 30-element 436CP30. M- Squared also has longer versions of these antennas, and omnidirectional eggbeater antennas for both bands. Quality components are used throughout. Many satellite enthusiasts have had excellent results with M-Squared products.

The finest, and also the most expensive, antennas are made by KLM. Two versions of the 2 meter crossed yagi are available. One has 14 elements and the other has 22. Just the 2M-22C (22-element antenna) includes switcher and stainless hardware. For 70 cm, there is either an 18-element or 40-element antenna.

More information

If you would prefer to build your own antennas, or to study the topic of antennas for space communications, consult *The ARRL Handbook, The ARRL Operating Manual, The Satellite Experimenter's Handbook*, many AMSAT publications, and the AMSAT HF and satellite nets.

Many discussions on the Internet through amsat-bb@amsat.org have approached the topic of effective antennas. To subscribe to amsat-bb, send a message to listserv@amsat.org. In the body of the message, simply type "subscribe amsat-bb." The system is not automatic, so it may be a few days before the mail starts coming through.

Ham Radio Fun

Number 64 on your Feedback card

Communications Simplified, Part 8

The secret world of FM.

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Mt. Kisco NY 10549

Last time we looked at AM radio; now it's time to get a bit more complicated and tackle FM, or frequency modulation.

Today, there are very few AM-only or FM-only radios made; most radios cover both AM and FM broadcast bands. So most of us listen to both AM and FM broadcast stations. Unfortunately, this often leads us to the wrong conclusions about their relative features.

Most people know that FM sounds better—it has better frequency response and less noise and interference, and can be heard in underpasses and tunnels, where AM fades out. They also know that you can hear AM broadcast stations farther away than FM stations, especially at night. They become convinced that these characteristics are true for all AM and FM. In reality, much of what we think about FM comes not because it is FM, but because commercial FM radio stations use different carrier frequencies from AM stations (VHF instead of LF), and they are allowed to use wider bandwidths.

AM broadcast station carrier frequencies are in the range from 0.55 to 1.6 MHz, and are limited to 20 kHz bandwidth. On the other hand, FM broadcast carriers lie between 88 and 108 MHz, and are assigned 200 MHz bandwidth. AM signals travel farther because of the lower frequencies, and FM signals can be heard better in underpasses and tunnels because of the higher frequencies. If AM was allowed wider bandwidths, it too could have a better frequency response. The major advantage that FM has over AM is that it resists noise and interference better.

"The major advantage that FM has over AM is that it resists noise and interference better."

Frequency Modulation (FM)

Just as amplitude modulation changes the amplitude of a carrier, frequency modulation changes the frequency of the carrier. There is also phase modulation which–you guessed it–changes the phase; we will discuss it later in this part.

Fig. 1 shows what we mean by FM. At the top, we see the audio waveform that we want to transmit (although we're talking about sending audio at this point, in reality you could send video, data, or any other kind of information via FM). In the middle is the carrier, as it would look before modulation. At the bottom is the resulting FM wave. As you can see, the frequency goes up (cycles are closer together) when the audio wave is high, and the frequency goes down (cycles farther apart) when the audio wave goes down (it could also be the other way–one goes up when the other goes down).

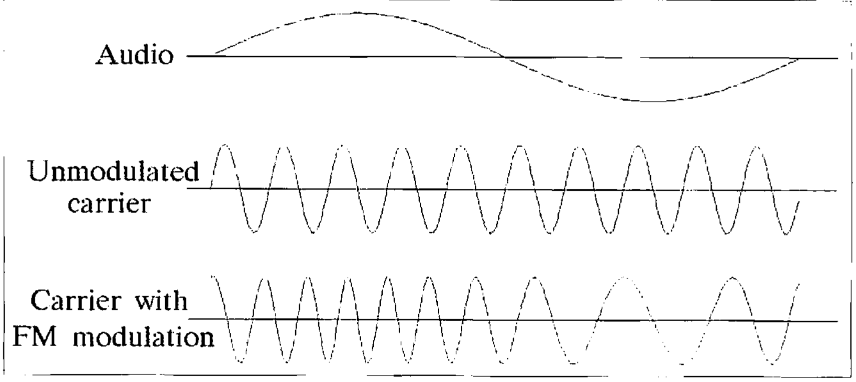

Fig. 1. Frequency modulation.

When there is no modulation (such as when an FM broadcast station transmits silence) the carrier frequency rests at what is called the *center frequency*; if you hear an announcer say "This is WXYZ on 96.3 MHz," that tells you what the center frequency is. Once the music starts, the frequency starts to vary above and below that center frequency; we say that it is *deviating* from the center frequency. *Deviation* is the word that describes how far it deviates from the center frequency.

DETOUR

Here is a short BASIC program that generates the picture in **Fig. 1**. You can experiment with it to see what happens as you change values.

```
10 'Program to generate FM
20 TWOPI=2*3.14159265
30 FAUDIO=1
40 FCARRIER=10
50 MODINDEX=5
```

```
60 SCREEN 2
70 FOR X=0 TO 639
80 T =X/640
90 AUDIO =SIN (TWOPI * FAUDIO * T)
100 CARRIER = SIN(TWOPI*FCARRIER*T)
110  FM =SIN(TWOPI*FCARRIER*T-MODINDEX*COS(TWOPI*FAUDIO*T))
120 PSET(X,50-20*AUDIO)
130 PSET(X,100-20*CARRIER)
140 PSET(X,150-20*FM)
150 NEXT X
160 IF INKEY$="" THEN GOTO 160
170 SCREEN 0
```

At 640 different values of X going across the screen, the program calculates the voltage of the *audio* signal and the *carrier* signal (whose frequencies are FAUDIO and FCARRIER, respectively), and then combines them into an FM signal. The three PSET instructions in lines 120, 130, and 140 then plot these values on the screen.

END OF DETOUR

FM differs from AM in many ways. Noise and interference usually corrupt signals by changing their voltage—by adding spikes, or in some other way changing the shape of the signal; they cannot change its frequency. Since FM signals only change their frequency, not their amplitude, it's possible to design a receiver that ignores amplitude changes (for instance, an FM radio often contains a *limiter* circuit which clips the tops off the signal to make the signal the same height no matter what level it comes in). The receiver will then ignore the noise altogether. This won't work for very weak signals, of course, since then there's nothing to clip, but for any reasonably strong signal, FM can be remarkably free of noise.

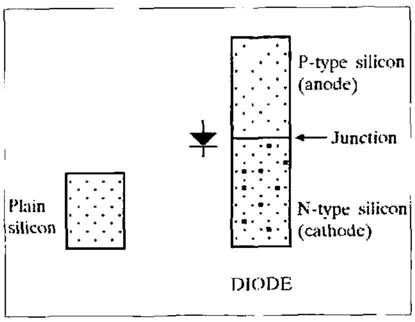

Fig. 2. Plain silicon and a silicon diode.

Producing FM

There are many ways to produce an FM signal. One way is to build an oscillator and wiggle its frequency back and forth in step with the modulation signal, using a special kind of diode called a *varicap*.

DETOUR

Most semiconductor diodes are made of silicon, which is a semiconductor—it conducts electricity, but not well, because its electrons are not very free to travel, so they cannot carry any substantial current. But it can be made into a better conductor by adding other materials to it. These make it less pure, and so are called *impurities*; the resulting impure silicon is said to be *doped*.

One type of impurity has *more* conduction electrons than silicon; since electrons have a negative charge, the resulting doped silicon is called N-type. It has an excess of electrons, and the new electrons which were added by the N-type impurity are now freer to move and therefore make the silicon into a better conductor.

Another type of impurity has *fewer* conduction electrons than silicon; this produces a lack of electrons, and leaves "holes"—places where the silicon would like to have an electron, if there were any around. This sort of doped silicon is called P-type, because these holes behave sort of like positive charges.

Think of this as a game of musical chairs. In the normal musical chairs game, there is a ring of chairs and a ring of people, but there is always one fewer chair than there are people. When the music plays, the people move from chair to chair, and when the music suddenly stops, everyone sits down. Of course, there is always one person without a chair, so he is "out," and so on. Suppose we reverse the game—instead of having one chair too few, put in one chair too many. Now there is always a chair free. As people move from chair to chair, ignore the people and instead focus your eyes on whichever chair is empty at that instant. As the people are moving in one direction, the empty chair seems to be moving in the opposite direction.

P material behaves the same way, except that the electrons are like the people, and the holes are the empty chairs. As a nearby electron jumps into a hole, it leaves another hole behind it. And so it looks as though the hole moved in a direction opposite to that of the electron.

Fig. 2 shows how this can be used to make a diode. On the left we see a piece of plain silicon. The dots show the positions of the electrons which might carry current if they were more free to move. The silicon is a crystal, and the atoms and their electrons form a neat pattern throughout the material.

On the right in **Fig. 2** we see how a semiconductor diode is made up out of two pieces of silicon. The anode is a piece of P-type silicon, while the cathode is made of N-type silicon. The place where they abut against each other is called the *junction*.

If you compare the P-type anode with the plain silicon, you will see that there are white areas where there are electrons missing; these are the holes. On the other hand, we drew some larger dots in the N-material to show the extra electrons added by the doping.

Now imagine that the diode is forward biased; that is, the anode is connected to a positive voltage, while the cathode connects to negative. Since the negative electrons are repelled by the negative voltage at the cathode, and attracted by the positive voltage at the anode, they start trying to move upward. Every now and then (quite often, actually) one of the extra electrons in the cathode will look across the junction, spot a hole on the other side, and jump into it. Of course, new electrons coming in from the negative terminal replace the lost electrons in the cathode, while the extra electrons in the anode jump from hole to hole and eventually go out the positive terminal. This gives us a current through the diode.

But now look at **Fig. 3**, which shows the diode reverse biased—that is, the anode terminal is connected to the negative terminal of a battery, while the cathode is connected to the positive terminal. Under these conditions, there is no current flow through the diode, simply because all the electrons up in the cathode are being attracted by the positive terminal of the battery, while all the holes at the bottom (which behave like positive charges) are attracted to the negative terminal of the battery.

Because all the electrons and holes are being pulled away from the junction, there is a region around the junction

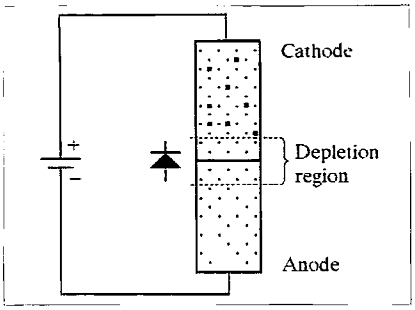

Fig. 3. Reverse-biased diode.

(sort of like a demilitarized zone) where there are no holes and no extra electrons. In electronics, this zone is called a *depletion region*, and you can see in **Fig. 3** that this region is just plain silicon-no extra electrons, and no holes.

The size of this depletion region depends on how much voltage there is. If the battery voltage is small, there isn't much pull on the holes and electrons, and the region is fairly thin. If the voltage is high, then the region becomes much larger. The depletion region acts like an insulator, and prevents current from flowing through the diode.

So the diode acts like a conductive region at the top, an insulator in the middle, and another conductive region at the bottom. That is the exact description of a capacitor—two conductors separated by an insulator. The diode therefore acts like a capacitor, but the capacity depends on the spacing between the conductors, which in turn depends on the applied voltage. Hence, this is a variable capacitor, or varicap.

Varicap diodes are specially made to exhibit large changes of capacitance with voltage, but all diodes exhibit this effect to some degree. For example, the common 1N4001 rectifier diode makes a dandy varicap for many purposes.

END OF DETOUR

Now back to FM modulation

To produce FM, we need to produce a sine wave carrier whose frequency varies with the modulation we want to put on it. One way to do this is to build an oscillator which will produce the carrier, and then vary its frequency in step with the modulation. If we use an LC circuit (a tuned circuit with an inductor L and a capacitor C) to set the frequency of the oscillator, then we can add a varicap across the LC circuit. The audio (or other modulation) is sent to the diode, changing its capacitance. This changes the resonant frequency of the tuned circuit, which, in turn, changes the oscillation frequency. Voilà—FM.

DETOUR

An oscillator is a circuit which produces an AC wave (the word *oscillate* means to swing back and forth). A typical oscillator consists of an amplifier, with part of its output sent back to the input by a *feedback* circuit.

Fig. 4 shows a circuit sometimes called a *feedback loop* or *servo loop*. An input signal (V_{in}) is applied to a combiner circuit (the circle with an X inside), and then to an amplifier which has a gain G. The output from the amplifier is V_{out}.

A portion of V_{out}, however, is sent back through a box whose gain is H, and combined with the input in the combiner; the combiner is also sometimes called a *summer* or *comparator*, depending on the application.

The normal equation for the overall gain of a servo loop circuit is

$$A = \frac{V_{out}}{V_{in}} = \frac{G}{1 - GH}$$

There are two possible things that can happen at this point, depending on whether we have *negative feedback* or *positive feedback*.

(A) Negative feedback. As we can see in **Fig. 4**, the actual input into the amplifier is a combination of the input voltage (V_{in}), and the feedback voltage. If these two signals are out of phase, then the actual input would be less than V_{in}, and, therefore, the output voltage from the amplifier would be less than if there was no feedback. In other words, the gain of the servo circuit is now smaller than the gain of the amplifier all by itself.

We can see this in the above equation. If the product of G times H is negative, then the denominator of the equation is larger than 1 (since subtracting a negative number is the same as adding a positive number). Dividing G by a number larger than 1 gives us a smaller number; in other words, the gain A of the entire circuit is smaller than the gain G of the amplifier by itself.

Since negative feedback reduces the gain of an amplifier, you may be tempted to think that it is a bad thing. Actually, though, negative feedback is used a lot because, while it reduces the gain, it also reduces the distortion of the amplifier and improves other factors. Almost every hi-fi amplifier uses it to improve operation.

(B) Positive feedback, however, is what we need to make an oscillator. With positive feedback, the signal being fed back into the summer is *in* phase with the input signal (V_{in}), and so it adds to the input. This gives the amplifier more input than it would otherwise have, and so there is a larger output voltage (V_{out}) than before.

Returning to our equation, suppose that the product GH was a positive number such as +0.5 or +0.8; it would then subtract from the 1 in the denominator, making the denominator smaller than 1. From the equation, we see that dividing the amplifier gain G by a number smaller than 1 would make the quotient larger. This increases the gain, but it also reduces the amplifier quality. If the amplifier produces some distortion, then some of that distortion is sent back to the amplifier and amplified again; the output therefore has even more distortion than before. Positive feedback is therefore not generally used in plain amplifiers, unless you need more gain than the amplifier can produce by itself.

Now, suppose that the gain G of the feedback circuit were carefully adjusted so that the product (GH) were *exactly* equal to +1. Then the denominator of the equation would be 1 - 1, or exactly zero! Since dividing the amplifier gain G by zero gives infinity as the answer, the gain of this servo loop would be infinite. In other words, there could be an output from the circuit even though there is no input. As it happens, that is exactly what we want from an oscillator!

An oscillator is therefore an amplifier with a positive feedback loop around it. The feedback loop is adjusted so that its gain H is exactly equal to 1/G at whatever frequency we want it to oscillate at

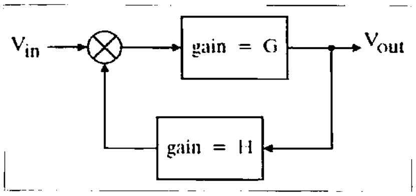

Fig. 4. A servo loop.

(so that the product of G X H is exactly equal to +1).

END OF DETOUR

Fig. 5 shows a Hartley oscillator circuit. The circuit is very simplified, and needs some more components to make it work. For example, there is no biasing for the transistor—but the important components are there. It works like this:

First, note the tuned circuit, consisting of inductor L1, and capacitor C3. This circuit sets the frequency of operation. At the same time, inductor L1 acts as an *autotransformer*. (An autotransformer acts very much like a normal transformer, but, to save money, it combines both the primary and the secondary windings into one. In this case, the entire inductor is the secondary, while the portion from the tap down to ground is the primary). Since the secondary has more windings than the primary, the output voltage from the autotransformer is larger than the input voltage and, therefore, the gain (which is actually the H in the above equations) is greater than 1.

The transistor is connected both as an emitter follower, and as a common-emitter amplifier. As usual, the emitter follower circuit has a gain slightly less than 1; this gain is the G in our previous equations. The output from the transistor goes into the tap of the inductor (the primary), while the output from the top of the inductor (the secondary) is the input into the transistor's base.

So the transistor provides the gain G (which is smaller than 1), while the tuned circuit provides the feedback H (which is larger than 1). Multiply the two out, and you get the product (G X H = 1) that is needed for oscillation. Once the transistor oscillates, the output is taken from its collector.

Now let's look at capacitor C2, and the components to its left. C2 is relatively large, so that at the frequency of oscillation it behaves almost like an AC short circuit. Hence, for AC purposes, the varicap diode

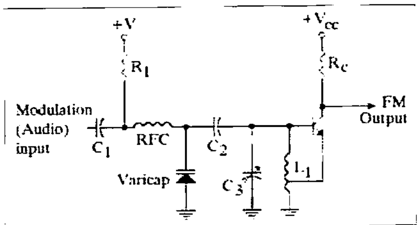

Fig. 5. A frequency-modulated Hartley oscillator.

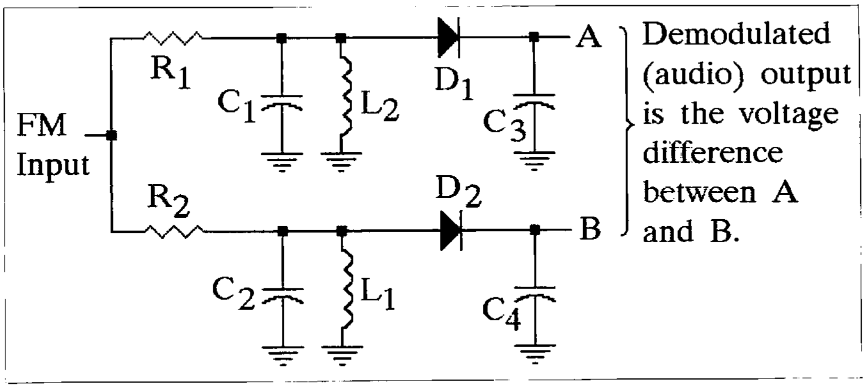

Fig. 6. A simple FM demodulator.

is connected directly across the tuned circuit. The exact oscillation frequency, therefore, depends not just on L1 and C3, but also on the capacitance of the varicap (notice the symbol for the varicap—a diode whose cathode side consists of two lines, like a capacitor).

In order to produce the depletion region in the varicap, the varicap is reverse-biased by connecting its cathode to +V through resistor R1, but note how the audio voltage comes in through capacitor C1 on the left. This audio voltage adds to, or subtracts from, the voltage +V, so the width of the depletion region varies with the audio. That changes the capacitance, which in turn changes the frequency of oscillation, giving us FM.

Finally, note the inductor labeled RFC. This is an RF Choke—a small inductor whose purpose is to keep radio-frequency signals from flowing through it. It keeps the high-frequency signal at the tuned circuit from getting back into the audio or +V bias circuit. Capacitor C2, on the other hand, does the opposite, keeping the audio and DC voltage across the varicap from getting to (and being short-circuited by) inductor L1. We can't connect the varicap diode directly across the tuned circuit since it has to be reverse biased, and the inductor would short the DC bias voltage.

There are other ways to generate FM, but the varicap circuit is the simplest and most obvious. Its disadvantage is that it produces some distortion; hence, it is most often used for voice or data communications, and seldom for high quality music.

Detecting FM

Just as there are various ways of producing FM, so there are many ways of detecting (or demodulating) it. Let's begin with the very simple circuit of **Fig. 6**.

Let's assume that the FM carrier has a center frequency of 10.7 MHz, and that it varies above and below that value. Let us tune the two resonant circuits so the top one, consisting of L1 and C1, is resonant at 10.8 MHz, while the bottom one, consisting of L2 and C2, resonates at 10.6 MHz. Further, make R1 and R2 the same, R3 and R4 the same, and C3 and C4 the same.

Start with the FM input at 10.7 MHz. The input signal is split by resistors R1 and R2 into two paths: Part of it goes to the top tuned circuit, part to the bottom. The top resonant circuit is tuned 100 kHz too high, while the bottom one is tuned 100 kHz too low, so the input signal appears across both tuned circuits, slightly attenuated (since the signal is not at resonance), but almost exactly the same amplitude.

Like the diode and filter capacitor in a power supply, diode D1 and capacitor C3 rectify the AC signal from the top tuned circuit into a positive DC signal, and filter it. Likewise, diode D2 and capacitor C4 rectify the AC signal from the bottom tuned circuit.

Since the AC signals across the two tuned circuits are about the same amplitude, the DC voltages across C3 and C4 are also equal. Points A and B therefore have the same voltage. The voltage between A and B is the actual output, which is zero.

Now suppose the frequency increases above 10.7 MHz. Since the signal is now closer to the 10.8 MHz resonant frequency of the top tuned circuit, the AC signal across that circuit increases; likewise, the AC signal across the bottom tuned circuit decreases because the input frequency is now farther away from the 10.6 MHz

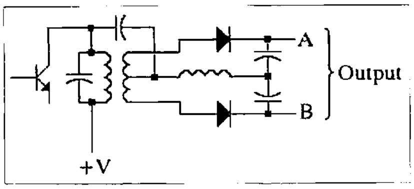

Fig. 7. Foster-Seeley discriminator.

resonant frequency of that circuit. Point A is now more positive than point B, and so the net output voltage is positive. In fact, the closer the input frequency gets to 10.8 MHz, the bigger the positive output.

In exactly the same way, if the input frequency drops toward 10.6 MHz, point B becomes more positive than A, and so the difference between A and B becomes negative. The more it drops, the more negative the output gets.

In other words, the output voltage is proportional to the frequency of the input signal—when the frequency goes up, the output voltage goes positive; when the frequency goes down, the output voltage becomes negative. This converts the frequency changes of the FM signal back into the original modulation.

While the circuit of **Fig. 6** would work, the fact that it has two tuned circuits makes it too difficult to adjust. It also has a bit too much distortion. Most receivers therefore use a slightly different circuit.

Fig. 7 shows one common circuit, called the *Foster-Seeley Discriminator* (don't confuse this with two companies, one called "Stearns-Foster," and the other called "Sealy"—they make mattresses, which have nothing to do with FM). By relying on the phase differences between several signals, the circuit produces voltages at the two diodes which depend on the frequency. By the time the signals are rectified and filtered, we again have a demodulated output which depends on frequency.

The circuits of **Fig. 6** and **Fig. 7** both have one disadvantage; their output

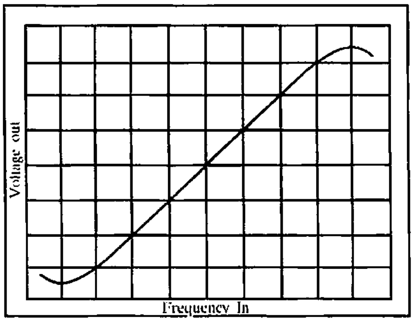

Fig. 8. The FM discriminator "S" curve.

voltage also depends on amplitude—the stronger the FM input signal, the greater the output voltage. This means that noise (which changes the input voltage) would get through the detector circuit. As we pointed out earlier in this chapter, one way to avoid this problem is to put a limiter in front of the detector; the limiter keeps the input signal at a constant height, and so avoids the problem. This means we need to add one more circuit to the radio, so many designers try to cut costs by using a slightly different circuit, called a *ratio detector*. Instead of taking the difference between the two diode outputs in a pair of resistors, the ratio detector looks at the *ratio* of the two diode voltages. Regardless of how strong or weak the signal is, at any given frequency the ratio of the two signals should be the same, and so this circuit ignores any amplitude changes in the signal. In many cases (especially in commercial FM broadcast receivers) that eliminates the need for a limiter, and cuts cost.

Fig. 8 shows the output-vs.-input curve of a typical discriminator or ratio detector; you can see why it is often called the "S" Curve. It shows how the output voltage (the vertical axis) depends on the input frequency (the horizontal axis). If the circuit is well designed, then the center of the curve should be as straight as possible, to make the output voltage exactly proportional to the frequency change, and produce the lowest distortion. The ends of the "S" curve are curved, but the FM signal usually doesn't change frequency that far up or down, so it doesn't matter.

FM sidebands

Like AM, transmitting an FM signal results in sidebands, and those sidebands increase the bandwidth of the FM signal.

Let's start by looking at **Fig. 9**. At the top, we have 10 cycles of an unmodulated carrier with a constant frequency. Note the vertical lines, which cross the carrier signal exactly at the top of each cycle. If you carefully measure, you will see that the distances between all the lines are exactly the same, which proves that each cycle is exactly the same length.

Below the carrier we see two sidebands: the upper sideband, with a slightly higher frequency (it shows 11 cycles instead of 10); and the lower sideband, with a slightly lower frequency (it shows only 9 cycles.)

In the bottom waveform, we used a computer to sum the carrier and sidebands to produce a resulting waveform. Like the unmodulated carrier at the top, it shows 10 cycles, but these cycles are not all the same width—you can see that the vertical lines cross the bottom wave at different places in each cycle. From this, we conclude that the FM signal at the bottom is changing frequency (because some cycles are longer and some are shorter), but that the average frequency is the same as the unmodulated carrier. In other words, modulating the carrier to produce FM varies the frequency back and forth, above and below the "resting" or unmodulated value.

We therefore see that, like an AM signal, an FM signal consists of a carrier plus sidebands. But there is one catch—if you examine **Fig. 9** carefully, you can see that the cycles of the FM signal at the bottom are not all the same height. In other words, the frequency is varying, but so is the amplitude. This can't be! There is something wrong here! FM is supposed to stay the same amplitude all the time, not change! What's wrong?

The problem is that **Fig. 9** doesn't tell us the whole story. **Fig. 9** would be good enough to explain FM *if the two sidebands were much smaller*. When the amount of FM modulation is very small (for example, when the music on an FM station is very soft), one tiny set of sidebands, much smaller than those shown in **Fig. 9**, is enough to swing the resulting FM carrier back and forth in frequency a small amount without changing the amplitude.

On the other hand, when an FM station transmits loud music (which produces much more modulation), the simple picture in **Fig. 9** needs something else (let's call it a "finagle factor"), something which will keep the amplitude constant.

This "finagle factor" is another set of sidebands. A real FM signal usually contains more than one pair of sidebands: there could be dozens or even hundreds of sidebands on each side of the carrier when there is a *lot* of modulation.

Fig. 10 shows how adding just one more set of sidebands can fix the problem of **Fig. 9**. Here we see the following: the original unmodulated carrier with 10

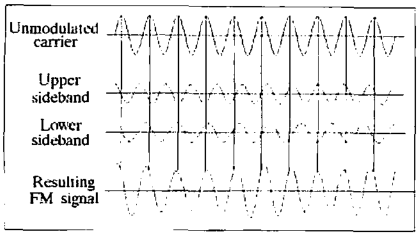

Fig. 9. FM from one set of sidebands.

cycles, one pair of 1st sidebands, an upper one with 11 cycles, and a lower one with 9 cycles, a pair of 2nd sidebands, an upper one with 12 cycles, and a lower one with 8 cycles, and the resulting FM signal with 10 cycles of varying frequency, but constant amplitude. So we see how adding just one additional set of sidebands (with frequencies different from the first set) can fix the amplitude variations.

As we mentioned earlier, with more modulation, even more sidebands might be required to keep the amplitude constant. So we need to learn how to measure the amount of modulation. This can be done in two ways—using the deviation, or using a modulation index. Two methods that will, unfortunately, have to wait until next time.

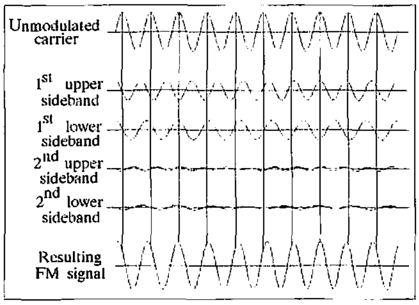

Fig. 10. Multiple FM sidebands.

NEVER SAY DIE

Continued from page 45

else. We had a ball converting the Command Sets, SCR-522s, and other stuff. And we learned from doing it.

For my part, I got started building stuff in 1937. It started with a box of old radio parts someone brought to the church and gave to my pal Alfie. He had zero interest in that old junk, so he gave it to me and I used the parts to build a cigar box radio. Which worked! I was hooked. Friends of my family dumped dozens of old radios from their attics on me. I took 'em all apart, building up my junk box. I hate to think what those old radios would be worth today if I'd boxed 'em up and stored 'em. Lordy.

Like everyone else, I memorized the *ARRL Q&A Manual* and passed my ham ticket. Sure, I could build things from magazine articles, but I hadn't a clue as to how elctricity worked. In that way I was like almost every other ham I'd met. When WWII came along we all got thrown off the air in December 1941. In 1942 I joined the Navy and they put me through a three-month course in the fundamentals of electricity at Bliss Electrical School. It was a fabulous course.

After that I went on to the Navy Radio Materiel School on Treasure Island (San Francisco) for six more months. By the time I graduated I could repair anything electronic: test equipment, receivers, transmitters, antennas, sonar, radar, and so on. Bliss gave me my understanding of the fundamentals which has helped me cope with the development of solid state, computers, and digital electronics.

After I graduated from Treasure Island I volunteered for submarine duty and was sent to Pearl Harbor as an Electronic Technician 2/c on the submarine tender Sperry. In 1943 I was transferred to the *Drum*, where I was in charge of everything electronic. And had plenty of exciting adventures...which are described in my *WWII Submarine* book.

That's the kind of thing amateur radio got me into.

Maybe now you can understand why I've been pushing ham clubs to provide technical sessions before every club meeting. These will help newcomers and old timers (too) build an understanding of the fundamentals instead of just memorizing the *ARRL Q&A Manual*, like we all did 60 years ago and newcomers still are doing today.

Not only is learning new things fun, but it also helps your mind develop. Like the rest of your body, your mind is a use-it-or-lose-it module.

If the newcomers to our ham bands aren't operating the way we want them to, that's due to what they're learning from us old timers, not what they may have brought from CB. If there'd been a CB band in the 1930s I'd have been on it and had a ball. With few exceptions, the absolute worst operators I'm hearing on our bands these days are old timers, not the no-code newcomers. That mess on 14.313 was all made by old timers. And look what K1MAN, who at 54 should know better, has been doing to our bands!

In the past our worst ever operators were all old timers. W2OY and W2BIB were infamous. OY used to sit on the low end of 75m on AM and put down sideband, newcomers, youngsters, and so on. BIB made his mark by doing his best to jam emergency medical traffic with Africa. Have any of you old timers any other nominations for the Ham Hall of Shame? Hmm, I almost forgot W2HH, who spent much of his later years jamming 75m DX contacts with CW. Say, wasn't he a former ARRL director, and the father of some forgotten ARRL president?

But for every Hall of Shamer we have ten hams who deserve medals for their contributions.

Getting back to the stuff in Florida Skip, there's a really stupid comment about the ham manufacturing and distributing lobbies influencing legislation. In some other field, maybe. But this guy, being relatively new, maybe hasn't noticed that the Japanese almost completely dominate the ham market here. Yes, they should fund a lobby, but unless it's been kept a secret (which is unlikely), they haven't. The American ham industry hasn't been able to get together to do anything. Most of 'em don't even bother to come to ham the industry meetings at Dayton. And when I offered to try and organize a manufacturer's group to work with the FCC as advisors, I got almost no response.

Twenty years ago we had an active FCC National Industry Advisory Committee (NIAC) which met in Washington with the FCC staffers to discuss ham regulatory matters. The Committee had originally been formed as a prestige deal which was completely controlled by the ARRL. Some ham FCC staffers got really fed up with NIAC doing nothing and organized a revolt which got rid of the pompous do-nothings and brought in some movers and shakers (including me). For several years all of us flew to Washington at our own expense to provide the guidance the FCC wanted and needed. I'll tell you more about that era some time.

It's a pity when ham publications help spread misinformation like that. Yes, it's a lot more trouble for writers to do their homework before writing, but then they'll be able to share their knowledge with us instead of displaying their ignorance and prejudices.

The New York World's Fair Fiasco

The Silent Key announcements for Bill Leonard W2SKE and Stu Meyer W2GHK, both around my age, got me to remembering some ham history that few hams today probably know about and most old-timers have forgotten. Bill used to be the president of CBS News and Stu was the president of Hammarlund. Both were good friends.

Bill and I spent a couple of months flying around the world together in 1959 on an Air Force C-54. We had a sideband ham station with us on the plane with which we made thousands of contacts as we flew from New Jersey to Newfoundland—Bermuda—The Azores—Scotland—Paris—Haderslev, Denmark—Berlin—Rome—Athens—Alexandria, Egypt—Aden—Karachi—Colombo—Bangkok—Saigon—Philippines—Naha, Okinawa—Taipei—Seoul—Tokyo—Guam—Wake Island—Honolulu—Travis AFB—Omaha—Dayton—Washington DC—and back to New Jersey. We got to know each other pretty well.

My story has to do with the New York World's Fair of 1964-65 and the ham radio exhibits therein. I'll tell the story as I recall it rather than digging out my old issues to get the details exact.

It all started when Bill, who was quite a celebrity as the head of CBS News, found out that Coca Cola was looking for a theme for their World's Fair pavilion. Bill called the president of Coca Cola and suggested that the exhibit be built around amateur

Continued on page 81

Number 70 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

From the spread of questions received from readers of this column, it would appear that you all divide into two basic groups. There is, of course, the experienced RTTY-phile contingent, and there is a group to whom much of this is a mystery. That latter group is the target of this and the next few months' columns.

The question to be addressed this month is, "Just how do you get digital information, letters, and numbers on a radio signal?" Remember that the technology we have today, computers and the like, did not exist when radioteletype started, so our system will have to allow for techniques of 50 or more years ago.

To begin with, understand that a "digital" signal is just one which is being turned on and off, which we can view as being alternated between a mark and a space state. So, let's begin without radio, by stringing a wire from here to there, and putting a light at one end and a switch at the other. **Fig. 1** will help with an understanding of this complex concept. If I want your attention, and I am here and you are there, I can just light the light. At the simplest level, we could even agree that one blink of the light means one thing, and two or three blinks means something else. The trouble with this scheme is that the number of blinks gets cumbersome fast.

So, along comes someone (I will leave alone the argument of whether or not it was Samuel F. B. Morse for now) who devises a code scheme that encodes all letters as groups of short or long pulses. Now we can use the wire and light to spell out words, numbers, and whole thoughts. Unfortunately, the code groups used for the letters and numbers are of varying lengths, making any attempt at automatically decoding them with some kind of mechanical device fraught with difficulty.

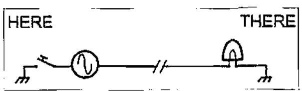

Fig. 1. A switch at one end of a wire that turns a light bulb at the other end on and off illustrates a crude form of code communication.

OK, so if we confine ourselves to just the 26 letters of the alphabet, and want to come up with a scheme that could automate transmission, we might brainstorm the scheme shown in **Fig. 2**. Here, 26 wires, one for each letter of the alphabet, are strung between two points. Extra wires could be used for numbers and punctuation, and one could even postulate stringing another wire for a SHIFT key, such as on a typewriter, to produce capital letters. Using modified electric typewriters at either end, we could have a workable scheme here. Of course, the expense of stringing who knows how many wires from here to there will be somewhat prohibitive, and looking into the mode's future, are we talking about 26 radio frequencies? The mere thought makes me shudder.

So, we have to get clever. First of all, let's look at just how you can encode information. One pulse, such as we have been using, can encode two states, ON and OFF. What if we used two pulses in sequences, each one of which can be on or off? With ON represented by "1" and OFF by "0," possible combinations would be 00, 01, 10, and 11—four distinct codes. In fact, the number of codes is two raised to the number of pulses used. So, using five pulses, 32 code groups are possible, enough to encode all 26 letters, as well as some punctuation and machine functions. A SHIFT function will give another set, for numbers and even more punctuation. **Fig. 3** shows, in chart form, the whole scheme, commonly called the Baudot or, more properly, the Murray code.

Well, we have a way of encoding the information, but how can we send it over a single wire or frequency? Well, we could back down to the multiple wire scheme, using only five wires—one for each bit of the Murray code. In fact, these days, we would call that "parallel" communication, and that really is how most computers talk to their printers. But that is not the topic of this column, and not the way radioteletype is transmitted. No, we are going to have to confine ourselves to one wire, or one frequency.

Although I will leave out some of the specifics, as they vary with machines, imagine a rotating wheel that encodes the five bits to be sent in sequence, producing a sequence of on and off pulses to describe each group. At the receiving end, we will place an identical rotating wheel, rotating at the same speed, which directs each incoming pulse to a magnet, which holds down a selector, which decodes the letter. Neat, huh? Of course, the two wheels need to be turning at precisely the same rate, and remain in perfect sync. Not an easy task, folks! Actually, this scheme is in use, and called "synchronous" transmission; it's just not the way we are used to doing it.

No, we took a simpler approach. Still two wheels, still rotating at the same speed, although speed is a tad less critical, but now add two pulses. A START pulse, always SPACE, is sent from the sending machine, and tells the receiving wheel to start rotating. Then come the five data pulses, with the receiver sampling only the middle of the pulse. By sampling the middle of the pulse, a speed drift of a few percent will not affect transmission. Finally, a STOP pulse, always MARK, concludes each character, and sets the system up for the next character. This "asynchronous" transmission, although it looks continuous, is, therefore, really a series of individual character bursts. **Fig. 4** is an attempt to diagram such a setup.

Now all you have to do is connect the two machines by wire or radio, and you have a workable scheme. As to the specifics of that radio connection, that is a topic for another column. Hopefully, this explanation helps demystify what some of you consider an enigma: Just how do letters and numbers get encoded onto one signal?

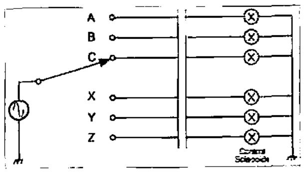

Fig. 2. A way for two machines to exchange information is to string 26 wires between them, one wire for each letter of the alphabet.

By the way, lest you think this scheme ends with radioteletype, if you expand the number of pulses to seven, you will have two to the seventh power, or 128 possible characters. Filling in all the upper and lowercase letters, numbers, punctuation, and some odd characters yields the American Standard Characters for Information Interchange, ASCII, the character set behind most computer communications. This asynchronous data transmission mode all started with a teleprinter. Imagine that!

Fast-forwarding to the present, but staying with the question of interfacing, I have a letter here from Elmer Sterkel KØUYE, of Loveland, CO, who is interested in the Snappy Video Capture mentioned a few months back. He has HP Deskjet 660C, and wonders how you hook the whole thing up.

Well, Elmer, if you only have one parallel port (see, I told you this would come in handy), you have to use a switch to select which device the port sees, the Snappy or the printer. The Snappy does not feed the printer port through, making such a switch mandatory. The alternative would be to use a second printer port, if one is available, or to install a card to create one. I purchased a switch from a local computer superstore for under $30. **Fig. 5** shows how to hook the whole thing up; it's really not very complicated. If you have a second printer port, just put the Snappy on LPT2, it will configure for that port and

Code Bits							Code Bits						
5	4	3	2	1	LTRS	FIGS	5	4	3	2	1	LTRS	FIGS
0	0	0	0	0	Blnk	Blnk	1	0	0	0	0	T	5
0	0	0	0	1	E	3	1	0	0	0	1	Z	•
0	0	0	1	0	LF	LF	1	0	0	1	0	L	)
0	0	0	1	1	A	-	1	0	0	1	1	W	2
0	0	1	0	0	SPC	SPC	1	0	1	0	0	H	#
0	0	1	0	1	S	BELL	1	0	1	0	1	Y	6
0	0	1	1	0	I	8	1	0	1	1	0	P	0
0	0	1	1	1	U	7	1	0	1	1	1	Q	1
0	1	0	0	0	CR	CR	1	1	0	0	0	O	9
0	1	0	0	1	D	$	1	1	0	0	1	B	?
0	1	0	1	0	R	4	1	1	0	1	0	G	&
0	1	0	1	1	J	'	1	1	0	1	1	FIGS	FIGS
0	1	1	0	0	N	,	1	1	1	0	0	M	.
0	1	1	0	1	F	!	1	1	1	0	1	X	/
0	1	1	1	0	C	:	1	1	1	1	0	V	;
0	1	1	1	1	K	(	1	1	1	1	1	LTRS	LTRS

Fig. 3. The Baudot, or Murray, code.

function just fine. The Snappy itself is widely available, and the price seems about the same at every source I have looked at.

Good luck, enjoy, and be sure to send me a sample of your efforts for inclusion in this column and on the web site.

The RTTY Loop Home Page, by the way, is continuing to attract a good deal of interest. Check it out at http://www2.ari.net/ajr/rtty for columns, downloads, links, and information on the growing RTTY Loop Software collection. I look forward to your questions and comments, by E-mail at ajr@ari.net, on America Online at MarcWA3AJR, or CompuServe at 75036,2501; or via snailmail to the address above. Be sure to include an SASE if you desire a response to snailmail correspondence. Next month, more on the series of basic radioteletype principles.

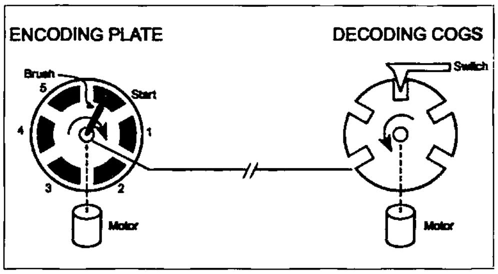

Fig. 4. The rotating wheels in each machine that spin at exactly the same speed are the backbone of "synchronous" transmission.

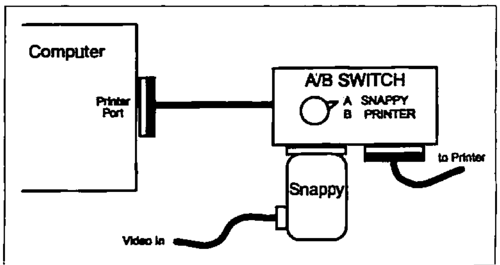

Fig. 5. How to hook up Elmer Sterkel KØUYE's Snappy Video Capture system when a second printer port is unavailable.

Ten-Tec ad is on page 59

QRP

Number 72 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

Summer will be quickly coming to a close, so let's preview a simple project to start off the winter building season. But first off, a condensed look at the QRP activity at the Dayton Hamvention 96.

QRP at Dayton Hamvention 96

The Four Days In May, for a first-time event, was a great success! All those who attended found the activity well worth the time and money. Without question, there will be another Four Days in May for 1997, but right now, I don't have the names or numbers to give you. When I know the people to contact, you'll be sure to find the information here.

The Friday night dinner was also a success! With over 100 people in attendance, it was the largest group we have had so far at the Hamvention. At the dinner, my two paid hecklers, Randy KD8JN and Scott N8JSK, conspired against me with bogus badges made up for the entire group. Somehow I became a spokesperson for a well known high power RF amplifier company. Not only did most of the QRPers at the dinner wear badges, the hotel staff did as well! Wait until next year!

Thursday and Friday nights were show and tell. Many of the vendors had equipment set up and running. S&S Engineering were showing off their new DDS VFO. Index Labs had the new QRP Plus on hand. Also on hand were the Atomic keyer, the Small Wonder Labs 20 meter SSB rig, the Wilderness Radio version of the Norcal 40, and the Sierra. I introduced my Micro "M" solar controller on Thursday evening. I know I missed some of the vendors: I always tell myself to make a list, but like the previous years, I forgot.

Clubs

We had, on Saturday night, just about every QRP club alive. The QRP ARCI, The M-QRP club, Norcal, New England, St. Louis QRP club, G-QRP, Colorado QRP Club, Northwest QRP club, and a few from out of the country. Making its debut was the QRP-L group, found on the Internet.

New stuff

I was surprised by the number of hams who were buying old QRP rigs and accessories. Heath HW-7s were going for $150. HW-8s were on the tables for over $200. Century 21s were $300, for the analog versions. In fact, someone (was that you, Doug?) purchased a used Ten-Tec microphone for the Argonaut 509 for $75! It's no wonder that the three I had on my table in the flea market went so fast. Had I known, I could have made a bundle. I had two Electro-Voice microphones, made for Ten-Tec, in the original boxes, and sold them Friday morning, as soon as the flea market opened. I wondered why the guy who purchased them didn't dicker. Oh yes, I sold the two for $20 each. The third one had no end plug—it went for $15. Oh well, live and learn!

QRP ARCI

Several items were taken up at the annual board of directors meeting. First, there will be a dues increase. The exact dollar amount has not been set at the time this is being typed. It's been a very long time since the QRP ARCI has had to increase dues, but it's become necessary because of the increases in postage and printing costs of *The QRP Quarterly*. Also, for DX members, the price of first class air mail is slowly bankrupting the club. Right now, a DX membership is $12. It costs anywhere from $3.70 to $6 for air mail, depending on the destination. It doesn't take a college education to tell you it costs more to mail out *The Quarterly* than we collect in dues. As a temporary fix, all DX members will have their copies mailed by surface mail instead of by air. This will be *only* for the short term. Look for QRP only ads to appear in *The Quarterly* as a means to offset the constantly rising postage costs.

Membership and subscription problems

If you have a problem with your membership in the QRP ARCI, contact me, not the prez, the vice prez, or the QRP-L group on the Internet. I'm the only person who can fix the problem. I, and I alone, have the database files. Write to me at the address at the top of the column. You can send E-mail at one of two addresses; 73357.222@compuserve.com or prosolar@imperium.net. I prefer that you use the E-mail going to the CompuServe address. Imperium net has been less than 50% available to me most of the summer.

Solar power revisited

Seeing three flea market spaces filled with solar modules and controllers, I noted a great interest in large high-power modules this year. In the years past, most of the QRP operators went for the 5 and 10 watt Solarex Lites. These make taking solar power and your favorite QRP rig into the field lots of fun. This year, most of the guys wanted larger, more powerful modules for use at home.

I also wanted a higher power module to increase my energy production, so I have installed two Astro power 120 watt modules on a pole mount. These modules will be used to test new control circuits. When not used for testing, their output will be redirected to the main storage battery. I plan on adding four more 120 watt Astro modules during the summer of 97. Also, two more 64 watt Solarex MSX-64 modules will be added to the main array before you read this. This will boost the peak current going into the storage batteries to over 73 amps at 17 volts. Although it isn't yet carved in stone, by the time you read this, my entire solar energy control system will be scrapped and a newer version in place. This time around we will go to a 24 volt system and use a single 3.5 kW modified sine wave inverter to supply power to the shack and the rest of the home. I will keep some of the low voltage lighting, now running on 12 volts, by using a DC to DC switching converter.

Low voltage fluorescent lighting can cause all kinds of RFI. The switching ballast used in the low voltage fluorescent lights generates a signal from DC to light! By using a separate inverter, I should be able to eliminate most of the RFI now caused by my lighting system.

A portable solar panel tester

This project came about out of a need to test surplus solar panels, without dragging along an expensive digital voltmeter. The tester will check for open circuit voltage and short circuit current of any solar module up to 180 watts. The maximum current the meter can handle is 10 amps.

The meter is very, very simple. In fact, instead of using a PC board, all components mount on a piece of perlboard. In fact, there are only a handful of parts needed.

The solar tester is built around a Jewel LCD meter display. The basic movement has a range of 0 to 200 mV. You can use just about any digital panel meter with an input of 200 mV. I've seen some really good prices for DPMs at hamfests. Some can be had for under $10.

To measure voltage, we need to scale the incoming voltage down to the level required by the meter. Since the open circuit voltage of a nominal 12 volt solar panel is around 21 volts, I scaled the meter to display a 200 volt range. So, when connected to an open circuit solar panel, you'll see 21.0 volts displayed. The 200 volt scale was needed because the meter would display an over range error if scaled to a 20 volt range.

To set the meter's scale, two .1%-tolerance resistors were used. These guys are available from Mouser Electronics™ for about two bucks each.

This gives us the voltage measurement. To measure current, I used 10 .1 Ω 5 watt power resistors in parallel. The total resistance for the 10 resistors is .01 Ω. With the meter's nominal 200 mV input across the shunt resistors, 10 amps of current will drop 100 mV, so the meter will display 10.0 amps. The combined wattage of the shunt resistors is 50 watts—the shunt should be able to take a 10 amp reading for 15 seconds or so before heating up.

The hardest part of the project is coming up with a simple

Continued on page 83

Your E-Mail Classroom Connection

NTS and digital communications.

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Students love to communicate. They don't want to feel left out of anything! Many female middle school students are even known to write lengthy messages to fellow students, chock-full of all the latest information, when the slightest need is perceived. To harness this energy, and to take advantage of middle-schoolers' innate desire to know what other students are doing everywhere, radio E-mail fills the bill. While landline Bulletin Board Systems (BBSs) can pass E-mail, you need a modem and a computer to receive the mail. Using packet, you have the option of utilizing the ARRL's National System (NTS) for delivery via a friendly telephone call or communicating directly with other schools who use packet radio.

To use packet radio in the classroom, proper preparation must be made for a successful experience. A number of issues must be addressed:

What equipment is needed?

A basic packet radio system consists of a VHF transceiver, antenna, Terminal Node Controller (TNC), and computer/software or data terminal. You don't need to have a big full-blown VHF monster station to participate actively. A successful project may be accomplished from a permanent station, or a portable one, using a laptop computer. TNC. and an HT with a rubber duck antenna.

```
                    73

         All the Best of the Holiday Season!
                   from
            KZ1Z and the BEARS
The Bethel Educational Amateur Radio Society
```

Fig. 1. Sample message.

What is the purpose of your communication?

Before sending out any message you must have a purpose. No one appreciates radio junk mail; it ties up nets and clogs up busy packet frequencies and computer space on packet bulletin boards. Some message subjects to consider when starting out include interdisciplinary work combining technology and language arts, computer science, art, science, math or other academic disciplines of the curriculum. The beauty of this medium is that you are limited only by your own imagination and common sense.

```
| We hope that you had a great summer. The school year |
| ahead is ripe with opportunities for personal and |
| academic growth. The BEARS wish you a fantastic |
| school year filled with ham radio fun. |
|
| 73 Pete, KZ1Z and The BEARS |
| Bethel Educational Amateur Radio Society |
| Bethel Middle School |
| Bethel, Connecticut |
```

Fig. 2. Sample message.

Surveys requesting information on a variety of subjects, such as political straw polls, musical groups, or other student-oriented issues, will usually strike a responsive chord among fellow students. Data retrieval for scientific interpretation or mathematical statistical work is an excellent first project for packet E-mail. For example, you may ask participants to send in the high and low temperatures for their area on a specific day or week, identifying their geographic location by using longitude and latitude. The data may be used for lessons in social studies classes, for meteorology lessons in science class, or in mathematics for drawing charts and graphs. You could even share the data for input in computer science classes for spreadsheet work, transforming the data into a variety of graphic representations.

Celebration messages are a lot of fun. Students can send messages to other students and schools wishing them all the best during a holiday season, congratulating them after the school has received an honor or award, or praising a successful sports endeavor.

ASCII graphics can be especially effective for spicing up messages via non-NTS (the ARRL National Traffic System) circuits. Keyboard art has been a part of amateur radio for years on RTTY and it has a place on packet. too (be careful not to send long pictures, as they won't make you many friends in the packet world). Recent software and TNC developments also allow for ANSI picture transfers, but special care must be taken to be sure that the format is appropriate, as you would not want to send control characters, which may be misinterpreted by non-compliant systems. ANSI graphics are not compatible with DX packet clusters.

Just being a nice person has its own rewards and is an ideal way of facilitating personal communications. Consider contacting former students who have moved away from the community, just to ask how they are doing. A friendly message from back home is always appreciated. Packet may also be used to

```
         o  School will be starting soon. The BEARS wish you
    _ /-_    all a GREAT school year, full of high
....(_)>(_)  academic achievement and ham radio fun.
_________
             73...Pete KZ1Z & the BEARS
      The Bethel Educational Amateur Radio Society
                 Bethel Middle School
                  Bethel, Connecticut
```

Fig. 3. Sample message.

keep alumni students informed of local events and reunions. "Happy Birthday!" messages are always fun. You may wish to seek out new students at your school and ask them if they would like to send a message to a friends back at their old schools or communities. This is an excellent way to bridge that awkward gap that exists whenever a student moves to a new town. It also gives students an opportunity to learn more about their peers and about other areas of the country. Military personnel also appreciate being remembered. Radio links in conjunction with MARS should also be explored.

What system would be best for getting the message out?

NTS, the ARRL-sponsored National Traffic System, is an excellent way to get the messages out. Disseminating messages through NTS keeps the system alive and builds strong ties in the local and section levels.

While we often think of packet as the primary method of getting the messages out digitally today, you should not overlook the potential use of other modes, such as APLINK, AMTOR, PACTOR, HF packet, and RTTY. Many areas of the country also have long-established VHF packet to HF digital links.

Message preparation

Messages should always be prepared in accordance with proper NTS format (see Appendix A) if you are not sending a message to a specific amateur radio station's home BBS. It is recommended that you also have a copy of the ARRL numbered radiograms.

The effective use of a text editor to prepare your messages off-line is strongly advised. This will allow you to verify content information, to check spelling, and to generate a bulk loading text file to upload messages efficiently. See Appendix B for details. Remember to always save your messages in a pure ASCII format. Imbedded control characters associated with specific word processing programs will cause problems during transmission and later printing.

If you will be uploading messages to a local BBS on a steady basis, it is a good idea to contact your local sysop ahead of time to set up forwarding paths and to see what other suggestions he or she can offer.

Have fun!

Infusing radio E-mail into the classroom offers many opportunities and readily yields positive results. The educational process is enhanced by such hands-on practical activities. Many pen pals and long-lasting friendships (and funny stories, too) have been garnered through this medium. One divorced mother, living in another state, received a message from her son, delivered by a friendly radio amateur operator. The son reported to the class that his mom called him on the telephone late that night all excited to say that she had received his note. She then asked him to send another message, so she could chat again with the gentleman who delivered that previous message! One never knows where the power of E-mail will take you.

Working with digital communications over radio is like second nature for today's students who have grown up with computers, as they begin to understand that the Super Highway of tomorrow will extend to the sky, and will not be limited to traditional landlines.

"Appendix A" continued on page 76

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--,-------------------------------------------------------------
| |* * * * * * * *  ___________________________________________|
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| |* * * * * * * * *___________________________________________|
| | * * * * * * * * ___________________________________________|
| |* * * * * * * * *___________________________________________|
| | * * * * * * * * ___________________________________________|
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| |____________________________________________________________|
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| |____________________________________________________________|
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| |____________________________________________________________|
| |
| |
| |  Remember our Veterans, for without their contributions,
| |       Old Glory would not be flying and the greatest
      democracy in the world would be just a history lesson.

               Pete KZ1Z and the BEARS
      The Bethel Educational Amateur Radio Society
                 Bethel Middle School
                  Bethel, Connecticut
```

Fig. 4. Sample message.

Appendix A: ARRL Radiograms

The handling of radiogram traffic was the basis for the formation of ARRL, and a sizable segment of amateurs still makes this its principal amateur radio operating activity. Amateur radiogram service does not compete with other services, since there are no charges and there can be no guarantee. Provided FCC and international regulations are complied with, messages may be accepted from anyone for sending by amateur radio.

What constitutes "legal" messages, or any other kind of third-party communication, has been a matter of considerable discussion and various interpretations throughout the years. The pertinent regulations sections are: 97.3b, which defines an amateur operator as being a person "without pecuniary interest;" 97.112, which forbids any remuneration or other kind of compensation for use of an amateur station; and 97.114, which details certain prohibitions on third-party traffic.

Generally speaking, personal, non-business messages may be exchanged between different countries only after a special agreement has been reached between the countries. A list of countries which have signed such agreements with Canada and with the U.S. appears frequently in *QST*. In addition, most countries do not object to actual emergency radiograms being handled in the amateur bands if government or commercial facilities are not available at the time. Individual amateurs handle radiograms in a number of different ways. Some are "free-lancers" who handle their traffic on individual schedules without recourse to regular nets. Most traffic operators, however, participate in nets of various kinds. The largest organized system of nets is the ARRL National Traffic System. Others include networks organized by individuals for traffic-handling purposes in which individual amateurs participate out of preference.

Originating radiograms

Any amateur can originate a radiogram on behalf of another individual, whether or not this individual is a licensed amateur. It is the responsibility of the originating amateur, however, to see that the message is in proper form before its first transmission because under most circumstances it is improper for a relaying or delivering station to make changes.

Each radiogram originated and handled should contain the following component parts in the order given:

(a) Number
(b) Precedence
(c) Handling instructions
(d) Station of origin
(e) Check
(f) Place of origin
(g) Time filed*
(h) Date
(i) Address
(j) Text
(k) Signature

*Optional with originator.

a) Every radiogram transmitted should bear a number. Keep a sheet with a consecutive list of numbers (beginning with "1") at your operating position. When a radiogram is filed at your station for transmission, complete all parts of the preamble except the number, leaving this blank. When you send the radiogram, assign a number to it from the number sheet, crossing out numbers on the sheet as they are used and making a notation, after the number, of the station to whom the radiogram was sent and the date. Such a system is convenient for quick reference purposes. Most traffic handlers start with number 1 at the beginning of each year.

(b) Every radiogram has a precedence in amateur procedure. This will normally be "Routine" (R). It is a separate part of the preamble and is transmitted as such, not as part of the number. Other precedences are "Emergency" (never abbreviated), "Priority" (P), and "Welfare" (W).

(c) Handling instructions (HX) are available prosigns for use when or if desired by the originator or the originating station, whenever special instructions are required in the handling of the radiogram.

(d) The "station of origin" is the call of the station from which the radiogram was first sent by amateur radio and is included so that handling stations will be able to communicate with the originator if something interferes with the prompt handling or delivery of the message.

(e) The "check" is the number of words and numerals in the text of the radiogram. Handling stations should agree on the check before the message is considered handled. (Full information on checking radiograms will be given later.)

(f) The "place of origin" is the name of the place (city or town) from which the radiogram was started, not necessarily the location of the station of origin. The preamble of a radiogram filed at League headquarters in Newington, Connecticut, might read as follows: NR 457 R W1INF 21 NEWINGTON CT 2057Z JUNE 11.

If a message is sent to your station by mail or otherwise not filed in person, the preamble should show the place the radiogram originally came from. If the radiogram came to League Headquarters by mail from Wiscasset, Maine, the preamble would read: NR 457 R W1INF 21 WISCASSET MAINE 2057Z JUNE 11. Any radiogram received at an amateur station by any means other than amateur radio is an origination when put on an amateur circuit by that station.

(g) The time filed is the time at which the radiogram is received at the station from which it is to be sent. Standard practice is to use UTC. This part of the preamble is optional with the originating station.

(h) The month and the day of the month that the radiogram was filed at the originating station. The year is not included. If the filing time is UTC, be sure that the date agrees.

(i) The address is the name, street and number, city and state of the party to whom the radiogram is being sent. The telephone number should be part of the address. A complete address should always be given to ensure delivery. When accepting a radiogram for origination, this point should be stressed. In transmitting the message by CW, the signal "AA" is used to separate parts of the address, and the address is followed by "BT," or "break," before the text is started.

In street addresses where the words "east," "west," "north, or "south" are part of the address, spell out "the words in full. Suffixes like "th," "nd," "st," etc., are not recommended. Example: "19 W 19th St" should be "19 West 19 St." It is not good practice for the relaying station to change address format, but the originating station should observe the above practices to ensure clarity in retransmission.

(j) The text consists of words in the body of the radiogram. No abbreviations

should be substituted for the words in the text of the radiogram. The text follows the address and is set off from the signature by another "BT".

(k) The signature is usually the name of the person originating the message. The signature follows the "BT" or "break" at the end of the text. The abbreviation "sig" is not transmitted.

After the signature, say "end" or transmit "AR." If there is more to follow, say, "more." On CW, use the prosign "B." If there isn't any more to come, say, "no more." On CW use the prosign "N."

Counting words in radiograms

The amateur radiogram "check" is the count of the number of words in the text only. It is essentially an "as sent" count. While it is assumed that the rules of grammar and spelling will be followed, the check count is determined principally by the spacing used by the transmitting operator in sending the text. Since the first operator to transmit the radiogram is the operator of the originating station who enters the check in the preamble, this check should carry through to the destination. The relaying operator has no authority to change the check unless it is definitely determined that the check as he received it is incorrect, then he should confirm with the transmitting operator before making the change. When such a change is made, the original check should remain in the preamble. Example: An original check of 10 corrected to 9 would be sent "10/9" on CW.

The check is a means of ensuring the accuracy and completeness of your copy. It also indicates to the receiving operator how many words the radiogram he is about to copy will contain. Inclusion of "check" in a message preamble is not optional.

Numbers, ciphers, mixed groups and punctuation each count as one in the check, regardless of length. It is recommended amateur practice not to use punctuation, fractions or other unorthodox or seldom used code symbols in messages as such, but rather to spell these out when used in the text of a message to avoid complications in checking. The letter "X" or "X-ray" is used in place of a period or semicolon and is counted in the check.

Special note: The ARRL-recommended procedure for counting the telephone number in the text of a radiogram is to separate the telephone number into groups, with the area code (if any) counting as one word, the three-digit exchange as one word, and the last four digits as one word. For example, 203 666 1541 counts as three words in the text of a message; 666 1541 counts as two words. Separating the phone number into separate groups also minimizes garbling.

The principle of counting words as sent can be illustrated by a few examples, as follows:

New York City....3 words
NYC.....................1 word
Fifty six..............2 words
527B.....................1 word
H O Townsend....3 words
W1YL/4............. 1 word

A few rules must be observed in sending words so that this principle of "counting as sent" will not be abused:

1) Make your spacing methodical and accurate on both phone and CW.

2) Follow the dictionary wherever possible.

3) Do not waste time in traffic nets arguing about "how to count." The purpose of the "check" in amateur work is to confirm the number of words or groups in the text. "QTB" is a useful signal in confirming check. Once you are sure that you have copied it correctly, "QSL" (on CW) or "roger" (on phone) the radiogram and get on with the next one, correcting the check when you relay the radiogram.

In copying traffic, whether by pencil or typewriter, it is quite easy, with a little practice, to count the words in the text as you copy. When using a pencil, copy five words to a line. At the end of the radiogram, you can readily figure the number of words by the number of lines (plus how many words over) you copied. By typewriter, it is more convenient to copy 10 words to a line, and this can easily be done by copying five words, hitting the space bar twice (instead of once), copying five more words, then line spacing to begin a new 10-word line. At the end of the radiogram, a glance at the number of lines will show you how many words you copied. You can then query the sending operator if your figure does not agree with his.

When traffic is heavy and time is precious, it is not considered advisable practice to query a check unless you have reason to believe that a mistake was made in either sending or copying.

ARL check

Messages containing ARRL numbered radiogram texts (see form FSD - 3) have the same form as any other radiogram, except that the symbol ARL (*not* ARRL) is used before the check. This symbol indicates that a spelled-out number in the text of the radiogram refers to a complete text bearing that number on the ARL list.

In delivering a message with an ARL text, you (of course) deliver the complete text. It is therefore very necessary that the symbol ARL be included with the check to avoid the possibility of delivery of a meaningless number to the addressee.

Use of ARL text is a special tool for special occasions. When used, it should be used properly to avoid delays and confusion.

Appendix B:
Sample Bulk Text Format

S WA3TQJ @ WA3TSW.PA.USA.NA
QTC

/EX
S KA4FZI @ KE2IX.#MYFL.FL.USA.NA
QTC

/EX
S KD8YY @ WB8CQV.WV.USA.NA
QTC

/EX
S WB1GXM @ WA1DSW.NH.USA.NA
QTC

/EX
S KBØCUS @ WBØAEX.KS.USA.NA
QTC

/EX
==========

Note: By using your text editor, you may use a Find and Replace routine to substitute "QTC" in the file with another "Topic" line.

Insert the required text in the space between the "QTC" and "/EX." "/EX" must be used to terminate the message as Control-Z will not work during bulk uploading.

When using NTS protocol, the "S" command should be substituted with an "ST" command. The receiving station becomes a ZIP code and the home BBS transitions to the proper NTS route, e.g. @ NTSCT.

Number 79 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92633

Bringing ARDF to your town

"An on-foot foxhunt sounds like a blast! Where's the nearest one?" That's the gist of many responses to my recent columns about world-class radio direction finding (RDF) contests. If the writer is in Scandinavia, northern Europe, or eastern Asia, the answer is easy. This radio sport is popular there and weekly events take place in some cities. But it's still a new concept in North America.

While you can go on a mobile T-hunt every weekend in cities and towns all over the USA, international-style hunting is just beginning to catch on. My best advice is that if you want to go foxhunting, put on a foxhunt or two yourself. Once the sport catches on in your area, you'll have lots of hunts to go on in the future. You may even end up at the World Championships!

Organizing a hunt can be almost as much fun as going on one. April (WA6OPS) and I had the privilege of assisting at international competitions in 1991 and 1993. That made us bold enough to put on two on-foot foxhunts here in southern California. A lot of work went into each one, but everyone agreed they were worthwhile and great fun. From these experiences, I have lots of hints and advice for staging such events.

Photo A. Distinctive awards add class to your fox-tailing contest. April Moell WA6OPS designed this trophy for the overall individual winner of VHF-96.

First, a few words on terminology. "Foxhunting" is a widely-used name for any type of competitive direction finding, particularly international-style on-foot hunts. The term appears to have originated in the late 1940s. Some stateside hams have adopted it to refer to mobile hidden transmitter hunting, too. Unfortunately, non-hams frequently confuse it with the British horse-and-hound sport and get the impression that we are putting defenseless furry animals in jeopardy.

In Japan and China, the terms "fox-teering" and "fox-tailing" are gradually replacing "foxhunting." Swedish hams officially began describing the sport as *Radiopejlorientering* (Radio Direction Finding Orienteering) in 1973. It's accurate, but awkward. Most International Amateur Radio Union (IARU) national member societies have adopted the abbreviation "ARDF" (Amateur Radio Direction Finding), not to be confused with the generic "RDF" abbreviation for any method of finding the source of a radio signal. From now on, "Homing In" will use "fox-tailing" and "ARDF" to refer to international-style on-foot contests and the term "T-hunting" when describing American-style mobile hunts.

Let's get started

Once you have decided to be your town's ARDF huntmaster, your first mission is to become thoroughly familiar with the basics of fox-tailing. If you haven't already, now would be a good time to read "Homing In" from December 1995, January 1996, and April 1996. I also highly recommend the Radiopejlorientering site on the World Wide Web (http://spitfire.ausys.se:8003/hsn/rpo.htp). There you will find basics of the sport, rules, equipment, results, and schedules of worldwide events.

The pages are edited by Hans Sundgren SM5SVM, with input from Lars Nordgren SMØOY and Per-Axel Nordwaeger SMØBGU. These hams hosted the last ARDF World Championships in 1994. Hans recently expanded his site to include lists of other sites and publications related to all forms of competitive RDF. You will even find the topic index of all "Homing In" columns since the beginning in November 1988.

Mobile T-hunts are often put on by one person with simple gear. Sometimes it's as easy as finding a good spot, turning on the T, and seeing who shows up first. On the other hand, a championship foxhunt always takes careful preparation and a small staff of volunteers to be a success, as you will see. The good news is that only one person needs to have a ham ticket. Consider getting help from anyone who likes outdoor activities. For instance, a local orienteering club was a big help in setting up the 1993 Friendship Radiosport Games foxhunt in Victoria, BC, Canada.

If possible, your hunt should be part of a big amateur radio gathering that will expose our sport to mainstream hams. My first fox-tailing experiences were part of the 1991 and 1993 Friendship Radio Sport Games, which were week-long get-togethers of hams from USA, Japan, Russia, and Canada. In addition to the hunt, these Games included CW competitions, DX contesting, and a trip to a hamfest. The hunts April and I headed up have been part of Hamcon-95 and the West Coast VHF/UHF Conference (VHF-96). If possible, make your hunt a sponsored convention activity. This will get you wider publicity, insurance coverage, and maybe enough cash to cover trophies, certificates, prizes, and refreshments.

An informal spur-of-the-moment RDF "treasure hunt" at a hamfest or picnic can be great fun. But it is better to plan ahead and make a "happening" of your event. Lots of advance publicity is a must. This increases your chance of attracting experienced foxhunters and it encourages everyone to make equipment preparations in advance. Put out the word via hamfest flyers, club newsletters, packet bulletins, and local landline BBSs. Follow up with calls to active T-hunters to make sure they attend and encourage them to spread the word. Remind everyone that all family members who have equipment can hunt—a ham license is not required. Make a special effort to contact hams who do amateur radio activities with schools, Scouts, and youth groups.

To increase attendance and promote fox-tailing, encourage local "ham celebrities" to attend and participate in your hunt. Personally invite club presidents, repeater owners, ARRL officials, and hams in the local media. Offer to provide RDF gear to them, if you have it, to get them to go out on the course. At VHF-96, our ARRL Division Director and Vice-Director competed, along with a representative from ARRL Headquarters Laboratory. They were good sports and their presence and publicity drew a bigger crowd.

Hunting for dollars?

Regional and world IARU foxhunting championships are true amateur events. Only medals and certificates are awarded to winners. But I think it's OK to encourage larger attendance by giving cash prizes at your hamfest hunt, if funds are available. At Hamcon-95 we awarded cash and trophies for the first five places in each age division, ranging from $50 for first place to $10 for fifth place. The cash prizes at VHF-96 were smaller, but the trophies were nicer (**Photo A**).

Another way to get a greater turnout is to include a team competition. International championships have gold/silver/bronze awards for individuals in four age categories, plus medals for national teams having the best combined individual scores. At VHF-96, we used this method to create friendly rivalries between clubs. Here is what we announced: "When registering, you may declare yourself to be a member of a team representing your club, city, family, etc. Each team may have a minimum of three and a maximum of five members. Each entrant may be on

only one team. (Or he/she may choose to not be on any team.)

"If a club/city/family has more than five hunters, they must split up into more than one team. A team may include members in more than one age division. Team awards are determined by the best three scores of the team members. Just as in the individual competition, scoring is first by number of foxes found and second by time. Team members may not help one another on the course in any way."

All but one of the VHF-96 hunters joined a team. The rivalries were as fierce as any Field Day club competition. One team even had its own cheerleaders (**Photo B**)!

At regional and world championships, there are always two separate contests on separate days. One is on eighty meters with keyed CW, the other is on two meters with MCW signals. Here in Region 2, all ARDF events have been on only 2s meters, where it is easy to use ordinary handie-talkies to get bearings. Almost every active ham has one, so the pool of potential 2-meter hunters is much larger than for 80 meters. Portable RDF sets for 3.5 MHz can be home-brewed readily and I plan to cover that topic in a future "Homing In," but for now we'll stick to 2 meters.

Finding the right spot

When SMØBGU and his friends chose a site for the last World Championships, they didn't have to look very far. Vast thick forests are plentiful all over Sweden. Its *Allemansratten* (Everyman's Right) principle of law allows citizens free access to any forest or field in the country. Swedish forests are so dense that you sometimes cannot see more than twenty feet in any direction. In an open field, competitors can easily watch one another and will tend to play "follow the leader," but not in a Swedish forest.

City dwellers will find site searching much tougher. Here in southern California, most large parcels of land are barren and arid. Who wants to do ARDF in the desert? For VHF-96, we considered and dismissed the mountains (too far away), the big regional parks (too crowded, admission fees charged) and flood control dam sites (couldn't get permission, liability issues).

We ended up selecting Hillcrest Park in Fullerton. It has lots of elevation changes and enough varieties of flora to be called a botanical park. It's hilly, shady, and close to the convention hotel. The city Parks Department seemed eager to have us and didn't insist on being indemnified as a condition for granting a permit. Hillcrest's only disadvantage is its small size—only 40 acres. While far too small for a world championship, it turned out to be excellent for this group of beginners; not too hard and not too easy.

If your hunt will be in a large forest, good maps are a must. Many European foxhunting champions are also skilled orienteers, insisting on detailed topographical maps with contour lines at 20-foot elevation intervals. Orienteers tell me that only a handful of parks around here have been mapped in this detail, certainly not Hillcrest Park. We ended up making enlarged copies of a 30-year-old map hand-sketched by the Superintendent of Parks. For a 40-acre hunt this was adequate; no one could get lost in a venue of this size. On the other hand, you will want to practice your triangulation skills with better maps if your hunt group is training for the championships.

Do not distribute maps to the hunters until just before the hunt starts. In fact, it is best if the hunt location is kept secret. This prevents competitors from trying to gain an unfair advantage by scouting out the venue, and it minimizes the possibility that hiders will be observed while setting out the foxes. VHF-96 hunters were told to gather at the hotel parking lot at 1 PM Sunday, at which time they were given a sheet with directions to the site.

Photo B. Including a team competition will encourage friendly rivalries and increases attendance at your ARDF event. Lara Garrabrant KD6AYO and Rachael Kent KE6GIO decided to be cheerleaders for the Orange County RACES team at VHF-96.

Do-it-yourself foxboxes

International rules are very strict about transmitter timing. Following these standards will give hunters experience with the timing cycle they will encounter at future international meets. Championship course foxes transmit for exactly 60 seconds each in numbered sequence. There should be no dead air time between fox transmissions and no overlapping of transmissions.

To meet these requirements, you need a set of identical high-stability timers, one per fox. No ready-to-use commercial foxhunting transmitters or controller/timers meeting these requirements are available in the USA at the time of this writing, so warm up the soldering iron. The Friendship Games hunt used home-brewed TBOX controllers designed by Ron Seese N6MBR. Plans are in "Homing In" for October 1991.

Kevin Kelly N6QAB and J. Scott Bovitz N6MI put the TBOX boards, transceivers, and sealed lead-acid batteries into rugged surplus ammunition cans (**Photo C**). TBOX provides CW audio and PTT timing to any 2 meter transmitter. It has crystal-controlled timing, but getting five of them to start up in proper sequence was tricky. A momentary power glitch will cause loss of synchronization.

Photo C. Surplus ammunition cans make excellent waterproof fox enclosures. Kevin Kelly N6QAB is preparing this foxbox for the Friendship Radiosport Games.

Here is another option to consider, though I have not tried it: Use dual-band handhelds for the foxes. The HT in each fox repeats UHF-to-2-meters with subaudible tone (CTCSS) control. Each fox responds to a different CTCSS frequency. A keyer sends MCW audio for each fox in sequence on the UHF control channel. The keyer also changes the UHF transmitter's CTCSS frequency each minute to select which numbered fox repeats the controller's transmission.

This method will give perfect synchronization, but it requires that the UHF control transmitter's signal be solid copy at each fox. Be sure to disable the 2-meters-to-UHF repeat function on each fox so that they do not retransmit each other's signals onto the control channel. If you use this method, or if you are interested in participating in development of advanced fox controllers for IARU-rules hunting, please contact me.

Teach 'em and sign 'em up!

If there are technical forums at your convention, be sure to have one on ARDF. Explain the basic rules, give tips for tracking, and show how to get bearings with a handie-talkie and simple accessories. In addition to the ARDF forum, we put on a "clinic" at VHF-96. Prospective hunters were invited to the hotel parking lot late Saturday afternoon, where

a couple of "easy" foxes had been put out for demonstrations and equipment testing.

Have a prominent sign-up table at the hamfest where people can register for the hunt. Staff it with people who are knowledgeable about ARDF so they can answer questions and encourage everyone to try it. Provide handouts that explain foxhunting and easy on-foot RDF methods. Set a deadline for registration so that you will have sufficient time before the hunt to organize your age divisions, start sequence, etc. Our convention hunts were on Sunday afternoon; the registration deadline was 5 PM Saturday.

OK, you've found a perfect site, built the foxes, spread the word, held a clinic, and registered a bunch of hunters. The hardest part is over. It's time to put out the transmitters, make a starting lineup, run the hunt, tally the scores, and hand out the prizes.

In Part 2 of this series, I'll take you through the process step by step. Meantime, get started on scheduling and site searching for an ARDF event in your own area. Don't forget to send a notice to me. Mail your letters and hunt photos to the address at the beginning of this article. Send E-mail to Homingin@aol.com or 75236.2165@compuserve.com.

The Homing In Web Site isn't quite ready yet, but I have paper copies of my handouts for our recent southern California ARDF events. They are excellent models for your own activities. My handout package includes sample promotional announcements, ARDF information flyers for the sign-up table, teaming information, rules handout for registrants, assembly point instructions, starting lineup/scoring form, and results list. To get the package, send a 6x9-inch self-addressed envelope with 78 cents postage on it (for three ounces) to my post office box. 73

NEVER SAY DIE

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radio, which was at that time a fast-growing, largely American hobby which was delivering thousands of engineers, technicians, and scientists into the workplace to support and further the American world leadership in electronics and communications. When Coke bought the idea, Bill put them in touch with the ARRL to implement it. This was going to be the biggest publicity coup for the hobby in history! Millions of people would get to see ham stations in operation and be able to send messages home to their family and friends from the Fair. There would be booklets explaining about ham radio and telling people how they, too, could enjoy this wonderful and educational hobby. Lonely? Not when you can turn on a switch and talk with people anywhere in the world!

The plans for having a dozen or so operating ham stations in a large central exhibit area as the main theme for the Coke exhibit unraveled when word leaked out that in return for a $25,000 donation to the League's Building Fund, the exhibit would use only Hallicrafters equipment. The other manufacturers were outraged. As was Coca-Cola, when they found out. So amateur radio ended up with a small out-of-the-way room up on the second floor of the pavilion, next to the toilets, and only reachable via a small stairway. Instead of millions of visitors seeing amateur radio at work and sending messages for them, it was viewed by hundreds.

Could visiting hams get to operate? Har-de-har. I got a lot of angry letters about that from frustrated hams who'd managed to find the place, but then had to stand outside the little room and look in through a window.

Stu Meyer, the president of Hammarlund, was particularly upset over the sell-out of the hobby by the League, so he

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Number 82 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Fix That Scope!

Last time, we began looking at the internal operation of an oscilloscope, with an eye toward fixing a broken one. Let's continue.

More power supply

We began at the power supply, assuming the scope was altogether dead. If you've gotten the supply going again, the scope should be working, if simple supply failure was the original problem. If it promptly died again, figure on a short somewhere, and use standard troubleshooting techniques, such as disconnecting circuits one by one to find the short.

If the supply comes up but the scope still doesn't work right, attack the problem in a logical manner—what *part* of the scope isn't working? If there's nothing on the screen at all, the first place to look is the trigger circuitry. The trigger starts the sweep when the incoming signal crosses a voltage threshold you set with the trigger level knob. If the trigger circuits are not working properly, they may inhibit the beam completely, resulting in what looks like a dead scope! Try setting the trigger for "auto" or "free run" operation. Sometimes, that'll get the beam moving. If you still see nothing, it could be a trigger problem, but most likely isn't. Instead, go back toward the power supply and make sure *all* of the output voltages are really there; sometimes, one of them will be missing or way off.

Dot's nice

If you get a good focused dot on the screen but it won't move, you can assume it is not a high-voltage problem. Is the dot unfocused? Try turning the focus control. If there's no change, something's out in the focus circuit or in the high voltage itself. Most likely, it'll be a diode or a very high-value resistor. Some of those resistors can be in the 10-megohm range or more, making them quite difficult to measure, but if you see a burned one, that's a pretty good indicator of trouble. If there *is* a bad diode, be sure to replace it with a suitable part; a 1N4000-type diode won't work here.

If you can focus the dot, that's a good indicator that the high-voltage section and focus divider network are working fine. Keeping the brightness low (to avoid burning the screen with the non-sweeping dot), try putting a signal into one of the vertical inputs. Just touching the input with your finger ought to do the job. Be sure, of course, that you've set the controls to display that input. If the dot becomes a vertical line, that indicates operation of the vertical section. If nothing happens, even when the vertical attenuator is set for maximum sensitivity, your vertical amplifiers are not working. Or, perhaps, they're not getting all of their required supply voltages.

Sweep me away

If you do get the vertical line, you're getting somewhere! At this point, the big question is why there's no horizontal sweep. Before you assume it's a sweep problem, be absolutely sure you haven't set the horizontal sweep to "external" or "X/Y." Those settings intentionally disable the horizontal sweep, permitting an external signal to drive the beam back and forth. With no signal, there'll be no sweep, even though there's nothing at all wrong with the scope. I would consider this obvious, and wouldn't even mention it, had I not done it myself a couple of times.

As with other problems, sometimes sweep failures can be traced back to the power supply. In fact, that's often the cause. I have one broken scope right now with precisely this problem. The tip-off is that the vertical amps' position controls have to be turned way off-center in order to put the beam on the screen. That suggests that one of the power supply voltages is not there, or is very low, causing one side of the electrostatic deflection to be quite weak, or causing the vertical amps to be very unbalanced. Only the long-awaited schematic will tell for sure.

If the supply voltages are all there but the sweep still won't run, either the horizontal oscillator or the horizontal amplifier isn't working. Unlike the oscillator, the amplifier is easy to check without another scope. Simply inject some other signal into the external or "Y" input, after setting the sweep for "ext" or "X/Y." If there's no horizontal movement of the beam, the trouble is in the amp. If, though, the beam does deflect, then the oscillator isn't working. Although that sounds like an easy fix, it can get tricky, because the oscillator is gated (stopped and started) by the trigger circuits. Separating the two systems (oscillator and trigger) isn't always easy. At this point, you'll need another scope: a DVM just won't get you very far.

Set the broken scope for free run or "auto" trigger, and see if the gating point, as shown on the schematic, changes from the state it's in when the controls are set for "normal" triggering. It may show pulses, or it just may change polarities, depending on the design. For instance, it may go from zero volts to 10 volts, or something like that. If nothing at all happens, chances are the trouble is in the trigger, not the oscillator, and the problem is causing the oscillator to remain gated off. Most trigger circuits are pretty complex, but they boil down to a comparator of some sort and a timing circuit to sync the oscillator. At the end of the chain is some kind of driver chip or transistor which supplies the gating signal to the horizontal oscillator. That driver is where most of the problems I've ever run into have been located.

If you do see the gating signal, but still have no sweep, suspect the oscillator. The horizontal oscillator itself is usually pretty simple. Basically, it's just a sawtooth wave generator, and may be little more than one or two transistors or IC gates. The tricky part about it, though, is that it is connected to a whole bunch of timing caps and/or coils, in order to provide the various sweep rates. These are connected to the big control you turn to select the rate. As with anything that depends on connections, the connections are often the problem. In particular, check the various switches and rotary controls for good contact. Of course, one of the transistors could be bad; I've seen it once or twice. If you replace one, you may have to recalibrate all the timing elements for the different sweep ranges. Yuck! Of course, if you don't need NIST (National Institute of Standards and Technology, previously the National Bureau of Standards) calibration accuracy, you can just match the ranges to what's shown on your borrowed scope.

Kitchen sync

If you have the opposite problem (the sweep runs but never syncs), at least you know the oscillator works! In this case, the trouble is almost certainly in the trigger circuits, most likely in that driver again.

Most scopes provide a locking of the trace when in the "auto" mode, but some don't. I spent a bunch of time trying to figure out why a newly acquired NLS Miniscope wouldn't lock in the "auto" mode, even though it locked fine when in the "internal trigger" mode. Then I called the company and found out there was nothing wrong with my scope; it was designed that way! On this particular model, the "auto" mode is really a free-run setting. So, before you waste many hours, be sure the scope is meant to do what you think it should be doing. Of course, if it used to work and now won't, you already know how it ought to be working.

Hold it

Better scopes have a feature called "delayed sweep," which lets you closely examine various parts of a long waveform, by delaying the start of the sweep by an amount of time you set with the delay knob. Delayed sweep is one of the most useful features on any scope, especially if you work with video signals. Sometimes, the delay circuitry can go out, although it doesn't seem to happen

often. The delay circuit works by intercepting the output of the trigger circuit and delaying it by the amount of time selected. It's basically just a couple of monostable multivibrators ("one-shots"), and isn't too complicated. But, like the horizontal circuit itself, the delay stage is connected to a series of timing elements via various switches and controls. If yours goes out, check those contacts before delving into the circuitry itself.

When using the delayed sweep, you should be able to see various pulses all around the delay circuit. If nothing's moving, something's getting lost somewhere. If the trigger pulse is present on the delay circuit's input, the problem is in the delay itself. If there's nothing coming in, trace back to the trigger circuits and see where the signal disappears.

Well, I think we've covered all of the common problems with oscilloscopes. Now and then, of course, you may run into a weird one that defies logical explanation. Hopefully, though, our exploration has helped you find your scope's failure, and you'll soon be back in business. After all, what would life be like without old faithful?

73 de KB1UM.

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formed a manufacturer's group and went to the other Fair exhibitors, looking for a place to show off amateur radio. He found it with the Venezuelan pavilion, which offered some space on the main floor of their pavillion. This one had ham gear from all of the manufacturers.

In order to get a license for the station they needed a ham club to back it. They found one in New York City that was game. I know you're not going to believe this, but the League fought the ham manufacturer's group all the way. They even got Herb Hoover Jr, the ARRL president, to go to Venezuela to try to convince the president of the country to close down the ham exhibit. Then they tried to get the FCC to close it down due to some claimed irregularities in the sponsoring ham club's election process.

The chap who did most of the leg work on the alternative ham station for the Fair was K2AOE, who got so upset over the ARRL moves to shut the exhibit down that he committed suicide. He took things too seriously.

Amateur radio did get exposure at the Venezuelan pavilion, but nothing like it would have had if we'd been the central feature at Coca-Cola exhibit. Little did the folks at Hallicrafters know that they would be put out of business (along with Hammarlund and just about everyone else in the ham industry) within two years as a results of the ARRL's self-promoting "Incentive Licensing" proposal.

I hope you enjoyed my bit of ham history. I'm sure it will anger the brainwashed who truly believe the League can do no wrong.

QRP

Continued from page 72

switching arrangement. I did not want to use a rotary switch or relays. I also did not want to move the test leads from one set of jacks to another. I ended up using a 4PDT switch having a center off position. God only knows where this one came from, but a check with several surplus houses should turn up something close. The center off position does exactly what the name implies. It turns the meter off. The meter runs from a 9V battery.

Standard banana jacks are used for the test leads. I always end up losing test leads for the different meters I have, and came real close to hard-wiring them in place.

Radio Shack™ has a slick plastic case with a built-in battery compartment. This made an ideal case to install the meter. I plan to have an engraved plastic panel made to give the project that "commercial" look.

I can now choose between current and voltage with the flip of a switch, without the need to swap test leads. It's accurate enough for me, and rough and tough enough to be kicked around in the toolbox. The meter also makes a great tool to keep on hand for Field Day.

Parts List for Solar Tester

The part numbers are from Hosfelt Electronics™ (1-800 524 6464)

.1 ohm 5 watt 5% power resistors # 47-155

Insulated binding post Red # 80-265

Insulated binding post Black #80-266

Test leads # 52-105

4PDT switch, center off # 51-310

Manufacturers: If you have a new product and want it considered for review in 73, please call 603-924-0058.

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the September issue, we should receive it by June 30. Provide a clear, concise summary of the essential details about your Special Event.

AUG 4

ANGOLA, IN The annual Land of Lakes Angola Hamfest, sponsored by the Land of Lakes ARC, will be held 7 AM–2 PM at Steuben County 4-H Fairgrounds, corner of 200 W & 200 N. VE Exams for all classes. Talk-in on 147.180; Packet 145.090; 444.350-131.8 Tone; 444.900/100.0; 224.94; and 53.050. Camping, swimming, chicken BBQ, amusement park, concessions, flea market. Outlet shopping malls nearby. For info and advance tickets, contact *Sharon Brown WD9DSP, 905 W. Parkway Dr., Pleasant Lake IN 46779. Tel. (219) 475-5897.*

BERRYVILLE, VA The Shenandoah Valley ARC will host the 46th annual Winchester Hamfest and Computer Show at the Clarke County Ruritan Fairgrounds, 6 AM–3 PM. VE Exams at 8 AM, administered by the Mountain ARC at Cooley School (across from the Hamfest). Pre-reg. requested. Tailgating. Talk-in on 146.22/82 and 146.52 simplex, W4RKC. Contact *Irv Barb KD4VHV, Rt. 3 Box 5385, Berryville VA 22611. Tel. (540) 955-1745.*

NORTH WASHINGTON, PA The Skyview Radio Society will have their annual Hamfest 8 AM–3 PM at the Washington Township Fire Hall, just off Route 380 on Route 66. Flea Market setup time is 7 AM. Talk-in on 146.604(-) and 444.900(+). Contact *Robert Reihms N3NOS, 192 North Washington Rd., Apollo PA 15613 USA. Tel. (412) 727-2194 after 9 PM.*

PORT HURON, MI The Eastern Michigan ARC Swap '96 will be held at Saint Clair Co. Community College Student Center, 8 AM–2 PM; setup at 6 AM. Walk-in VE Exams; bring a copy of your license, ID, upgrade certificates and VE Fee. Starts at 11 AM, no pre-reg. necessary. Trunk Sales. Forums. Table/Ticket reservation deadline is July 17th. Send orders with an SASE to *EMARC Swap '96, P.O. Box 611230, Port Huron MI 48061-1230.* For more info, call *(810) 367-3059.* Talk-in on 147.300(+) and 146.520.

RANDOLPH, OH "Hamfair '96" will be held by the Portage ARC at Portage County Fairgrounds in Randolph, 8 AM–4 PM. Huge Flea Market. Indoor Vendors. Unlimited Free Parking. Forums. WAS-DXCC Card Checking. ARRL Officials. Contact *Joanne Solak KJ3O, at (330) 274-8240.* Talk-in on 145.39/.600 and 28.390. Make ticket and reservation payments to *Portage Amateur Radio Club, 9971 Diagonal Rd., Mantua OH 44255 USA.*

WELLESLEY, MA The Wellesley ARS and the Babson Wireless Club will co-sponsor a Ham Flea Market 9 AM–1 PM at Pepsico Pavilion, Babson College, in Wellesley. Tailgating. Talk-in on 147.03/.63 Rptr. Contact *Barbara Holdridge N1ICQ, 107 Church St., Westwood MA 02090; (617) 329-2628;* or *Gerry Driscoll NV1T, 107 Church St., Westwood MA 02090; (617) 444-2686.*

AUG 9–11

VERNON, B.C., CANADA The 5th Annual Sky High Hamfest will be held by the North Okanagan RAC at Silver Star Mountain Resort in Vernon. HF Station. Satellite Station. Seminars. Keynote Speakers. Dealer Displays. Flea Market. Ladies' Programs. Children's Activities. Chair Lift, and more. Get more details from the *North Okanagan RAC, P.O. Box 1706, Vernon B.C., Canada V1T 8C3.* For hotel reservations, call *Silver Star, 1-800-663-4431;* or *Putnam Station 1-800-489-0599.*

AUG 10

CROSSVILLE, TN The Crossville Hamfest will be located at Cumberland County Community Complex, 8 AM–2 PM. VE Exams at 8 AM, pre-reg. only. The test fee will be collected at the Hamfest. For Exam info, write to *AC4AA V.E. Test Session, Rt. 1 Box 20 Legion Loop, Crossville TN 38555.* Exhibitors and tailgaters, for tables contact *Nick Smith WA4GKM, 108 Cardinal Loop, Crossville TN 38555 USA;* or E-mail *nickart@midtenn.net.* Or call him at *(615) 484-5137 (work), or (615) 484-8220 (home).* Talk-in on 146.865. Sponsored by the Plateau ARC.

DRYDEN, NY The 16th Annual Finger Lakes Hamfest will be sponsored by the Tompkins County ARC and will take place at the Dryden H.S. Flea Market. VE Exams on site, pre-reg. preferred. New Equipment dealers. RV camping overnight. Fri. Fri. set-up available. Handicapped accessible. Talk-in on 146.97(-). Contact *Ross Boyer N2ISU, or Lonnie Boyer N2WGW, at (607) 844-4302 till 10 PM. E-mail: rmb3@cornell.edu.*

VALPARAISO, IN The Porter County ARC Hamfest will be held at Porter County Expo Center, 1 mi. south of US 30, on State Rd. 49. Talk-in on 146.775(-)131.8 PL / 146.52. Tailgating. VE Exams 9 AM–11 AM. Setup at 6 AM. Contact *Rich N9QLQ, PCARC Hamfest, P.O. Box 1782, Valparaiso IN 46384-1782. Tel. (219) 762-0484.*

AUG 11

CHARLOTTE, NC The Charlotte ARC Hamfest and Computer Fair will be held 8 AM–4 PM at Roll-A-Round Skate Center, 8830 East Harris Blvd. Tail Gate spaces limited to first come, first served. Flea Market setup at 6 AM. Talk-in on W4CQ 147.06(-). Make checks payable to *Charlotte ARC* and send with an SASE to *Charlotte ARC, P.O. Box 33582, Charlotte NC 28233-3582.* Pre-reg. without SASE or received after Aug. 1st will be held at the door. For info call *Buck Escott WB4OTP, (704) 522-4971, ext. 3330.*

LEXINGTON, KY The annual Central Kentucky ARRL Hamfest will be held by the Bluegrass ARS, Inc. at Western Hills H.S., Exit 53 off I-64 in Frankfort KY. VE Exams, Forums, Dealer Exhibits, Flea Market. Indoor commercial vendor space is limited, so reg. early. Deadline is Aug. 1st. Contact *Bill De Vore N4DIT, 112 Brigadoon Pkwy, Lexington KY 40517. Tel. (606) 257-3343 days; (606) 273-8345 eves.*

ST. CLOUD, MN The St. Cloud Radio Club will hold its 48th annual Hamfest Aug. 11th. Talk-in on 146.94 and 147.015. For info and tickets, contact *WØSV, 401 Great Northern Dr., Waite Park MN 56387;* or *WØSV @ NFØH.#CMN.MN.USA.NOAM. E-mail: jmaus@cloudnet.com.*

AUG 17

BURFORD, ONTARIO, CANADA Burford Fairgrounds will be the location for the Brantford ARC Flea Market, 9 AM to ?. VE Exams. Talk-in on VE3TCR 147.150(+). For table reservations, contact *Richard La Rose VE3RLX, 153 Dunsdon St., Brantford Ont., Canada N3R 6N3, (519) 752-2437;* or *Brantford ARC, P.O. Box 25036, Brantford Ont. Canada N3T 6K5.*

RHINELANDER, WI The Rhinelander Rptr. Assn. and Northwoods ARES will host the Northwoods Hamfest, 8 AM–2 PM, at Sugar Camp Town Hall on Camp Four Rd. in Sugar Camp. Set up Fri. eve. Aug. 16th, 6 PM–10 PM, and Sat. morning at 6 AM. Talk-in on 146.940(-). Contact *Mary Berger NS9Q, 367 Lois St., Rhinelander WI 54501. Tel. (715) 362-9296.*

WARROAD, MN Lake of the Woods Rptr. Assn. will hold their Hamfest at Warroad Area Comm. Center, 222 Virginia Ave. NE. Warroad. Wheelchair accessible. Set up at 10 AM; open to the public at 1 PM. VE Exams at 11 AM–walk ins OK. Bring original and photocopy of current license, 2 IDs (one with photo), and a check for $6.05. Dealer and Flea Market tables free with paid admission if reserved in advance. Send check and SASE to *David Landby KBØHAP, RT. 3 Box 10, Warroad MN 56763. Tel. (218) 386-1092.* Talk-in on 147.09(+) and 147.00(-).

AUG 17–18

HUNTSVILLE, AL For a good time, stop in at the Von Braun Civic Center in downtown Huntsville and enjoy the 1996 Huntsville Hamfest. Open to the public Sat. at 9 AM, and Sun. at 8:30 AM. Dealer Show. Flea Market. Technical Forums. Banquets, and more. The nearby Huntsville Hilton Hotel will offer special Hamfest rates. Talk-in by K4BFT on 146.94(-) MHz. For more info, call *(205) 534-7175;* or check into *http://www.hamfest.org* on the Web.

YORK, PA Visit Memorial Hall at York Fairgrounds 8 AM–4 PM to enjoy the 41st Annual York Hamfest and Computer Show. Commercial Vendors; Software; Hardware; Accessories; Shareware; VE Exams on Sat. by Laurel VECs (no fees),

at Calvary United Methodist Church, 11 North Richland Ave. (1 block from the hamfest); pre-reg. encouraged–call (717) 751-9675. Electronics Flea Market. Banquet Sat. night; ATV Seminar. Handicapped accessible parking. Tailgating. Camping on fairgrounds with 3-point hookups available: contact York Fair Office (717) 848-2596. For hamfest reservations and info, contact *York Hamfest, P.O. Box 351, Dover, PA 17315; Tel. (717) 751-9675.* Talk-in on 146.97(-).

AUG 18

CLARENDON HILLS, IL The DuPage ARC Hamfest and Computer Show '96 will be held at the Hawthorne Race Course, 3500 South Cicero, Stickney IL. Commercial set up Sat., 3 PM–6 PM; Commercial and Flea Market set up Sun. at 6 AM. Hamfest hours are 8 AM–2 PM. Wheelchair accessible. For tables and Hamfest info, call (708) 985-9256. Advance tickets $4 each (before July 30th). Send check payable to *DARC*, with a No. 10 SASE, to *Hamfest '96, 7511 Walnut Ave., Woodridge IL 60517.* Talk-in on 145.250 MHz.

LAFAYETTE, IN The Tippecanoe ARA will conduct VE Exams at the American Red Cross Bldg., 111 N. 7th St., beginning at 1:30 PM. They will also be sponsoring a Hamvention in Lafayette.

RICHWOOD, OH The 19th Union County ARC Ham and Computer Fest will be held at the Broadway OH Community Bldg. There is an indoor location for vendors, and ample Tailgate space. Self-contained camping vehicles may park on the grounds. Vendor set up at 6 AM. Open to the general public at 8 AM. Contact *Gene Moore N8YRF, 24461 Claibourne Rd., Marysville OH 43040. Tel. (513) 246-5943.*

SALINA, KS The Central Kansas ARC, Inc. will sponsor a Hamfest at the Bicentennial Center Heritage Hall, 9 AM–3 PM. Flea Market. Commercial Vendors. YL and non-ham activities. Talk-in on 147.03(+). Contact Dan Cook AAØTT at (913) 263-8540, or by mail in care of *CKARC, P.O. Box 2493, Salina KS 67401-2493.*

NORTH TARRYTOWN, NY The Westchester Emergency Communications Assn., Inc. will hold their "WECA Summerfest 1996" at Yonkers Raceway, Intersection of I-87, Central & Yonkers Ave., Yonkers NY. All outdoor tailgating and more. Talk-in on 147.06/.66. Contact *Tom WB2NHC, or Jeanne Raffaelli N2NQY, at (914) 741-6606.*

AUG 23–25

VERNON, CT The Eastern VHF/UHF Soc. will host their 22nd VHF/UHF Conference at Quality Inn and Conference Center, 51 Hartford Tmpk. Route 83. The VHF-UHF Swap 'n' Sell and Antenna Measuring start at 8 AM. For Swap/Sell info, contact Mark Casey N1LZC, 303 Main St., Hampden MA 01036. Tel. (413) 566-2445. Make check or M.O. payable to *Eastern VHF/UHF Society*, and send to *Rae Bristol K1LXD, 328 Mark Dr., Coventry CT 06238. Tel. (860) 742-8650.*

AUG 24

BRIDGEWATER, NJ The Somerset County ARS Inc. annual Hamfest will be held at the Somerset County 4-H Center on Milltown Rd., just off Route 202. Time: 8 AM–1 PM. Set up at 6 AM. Talk-in on 448.175(-), or 146.52 simplex. Call Pete *WA2OCN, (908) 429-9093. SCARS, P.O. Box 742, Manville NJ 08835.*

ST. CHARLES, MO The St. Charles ARC (WBØHSI) will hold their annual Hamfest at Blanchette Park in St. Charles. For details, contact *William Horn NØYYS, RR 2 Box 240, Troy MO 63379. Tel. (314) 989-2441 9AM-9PM.*

AUG 25

CORUNNA, MI The 19th annual Five County Amateur Radio/Computer Swap and Shop will host the 1996 Michigan State Convention at Shiawassee County Fairgrounds, 2900 E. Hibbard Rd, starting at 8 AM. Set up at 6 AM. This event is co-sponsored by the Bay Area ARC; the Genesee County RC; Lapeer ARA; Mid-Michigan Wireless Assn., and Shiawassee ARA. Advanced sales end August 10th. No advanced trunk sales. For more info, call *Jan at (517) 893-3475*. For space and table orders, include an SASE with your request and send to *Five County Swap 'N Shop, 1214 McKinley Ave., Bay City MI 48708.* Talk-in on 147.020(+) or 146.520 simplex.

YONKERS, NY The Yonkers ARC will host a Hamfest/Computerfest 9 AM–3 PM at the Yonkers Municipal Parking Garage on Main St. Set up at 7:30 AM. AC power available with pre-reg. Free Tune-up Clinic. Talk-in on 146.865 Rptr. and 440.150 Rptr. Contact *Jim N2ONM, (914) 969-5182.*

SEP 7–8

BRANDON, MANITOBA, CANADA The Manitoba AR Museum will host its 2nd Annual Ham Fest on the grounds of the Manitoba Agricultural Museum at Austin Manitoba where MARM is located. Flea Market; Commercial Displays; Computer Fest; Radio Controlled Aircraft demo and display. Camping near the Fest site. Full-course Supper (by advance reg. only); Sat. night Dance/Social. VE Exams; Rabbit Hunts; more. Contact *Dave Snydal VE4XN, 25 Queens Crescent, Brandon Manitoba, Canada R7B 1G1. Tel. (204) 728-2463.* Packet: *VE4XN @ VE4BBS #HWD.MB.CAN.NA.*

LOUISVILLE, KY The Greater Louisville Hamfest/ARRL KY State Convention will be held at the Kentucky Fair & Exposition Center. Talk-in 146.28/88. Flea Mkt. Commercial Exhibits, Forums, FCC Exams. Camping available: call (502) 367-5000. For more information, call (812) 294-4905. Send advanced ticket reg. with SASE to *P.O. Box 34444-Q, Louisville KY 40232-4444.* For commercial spaces, call *(812) 948-0037;* Flea Market spaces, *(812) 282-4898.*

SEP 8

DUBUQUE, IA A Hamfest, Radiofest, Computer Expo will be sponsored by the Great River ARC, Iowa Antique RC and Historical Soc., and Computer Users Groups, 8 AM–2 PM at Dubuque County Fairgrounds. VE Exams by ARRL/VEC. Bring photo ID and one other form of ID, original current license and any CSCE forms applicable, a check or MO made out to ARRL/VEC. For more Exam info, contact *Carl Clark NØKAX, 2145 Delicia Dr., Dubuque IA 52001. Tel. (319) 557-9149.* For Hamfest info, contact *Loren Heber, (319) 556-5755; Jerry Lange, (319) 556-3050; Jerry Ehlers, (319) 583-1016; E-Mail: SHEBER@MWCI.NET;* or *Internet: http://galaxy.mwci.net/grarc/top.htm.* Send payments to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004.* Talk-in on 147.24/.84 Rptr.

SPECIAL EVENT STATIONS

AUG 3–7

OSHAWA, ONTARIO, CANADA The Ontario Northland "Polar Bear Express" will depart from Cochrane Ont. at about 0800 hours, for its 186 mile journey to Moosonee Ont. in the James Bay lowlands at the southern end of Hudson Bay. An additional passenger car will have several HF stations set up so that DXing can be done en-route. A station will be operated from the train station where part of the group will DX continuously from Aug. 3rd–

Aug. 7th. A second part of the group will head for the water and much sought after IOTA and Canadian Islands. Everyone is invited to come along and have some fun DXing from the train or the station, but you will have to cover all costs for travel, lodging and food. This event is sponsored by the Ontario Northland Railway, Durham Radio, and Alinco. Communications will be in English, Spanish, and Italian. For a rail schedule and round trip fees, call *Ontario Northland at (800) 268-9281*. For updates on the project, visit web page *http://www.durhamradio.ca*. To learn more about joining the expedition, contact Laird Solomon VE3LKS at *(905) 434-7339*; packet *ve3lks@va3bbs*; Internet *lsolomon@osha.igs.net*; *http://www.osha.igs.net/~lsolomon*. To get tourist info on Cochrane, Moosonee, and the surrounding areas, contact *Stephanie Wright at (800) 354-9948*.

AUG 9–10

MIDDLEBOURNE, WV The Tyler County AR Organization will operate KA8GOH from the 34th annual Tyler County Fair, 1400Z–2200Z Aug. 9th and 10th. Freq: Phone portion of General 80 thru 10 meters. For a certificate, send QSL and a 9"x 12" SASE to *TCARO, P.O. Box 287, Middlebourne WV 26149, USA.*

AUG 10–11

MT. DAVIS, PA The Somerset County ARC will operate station KB3BOD from the highest point in Pennsylvania. Operations will begin 1700Z Aug. 10th and end 2000Z Aug. 11th. Listen on the lower 50 kHz of the General class phone. The ARC will also broadcast on the CW bands of 10–80 meters as conditions allow. For a certificate send QSL and SASE to *KB3BOD - SCARC, 708 Casselman St., Confluence PA 15424.*

AUG 11

NEW KENSINGTON, PA Station K3MJW, commemorating the Centennial of the City of Arnold PA, will operate from 1200Z Aug. 10th–0400Z Aug. 11th, on 50.150, the lower portion of General phone; Novice CW on 10, 40, and 80 meters, and Novice phone 28.464. Sponsored by the Skyview Radio Soc. For a certificate, send QSL to *K3MJW, 2335 Turkey Ridge Rd., New Kensington PA 15068, USA.*

AUG 17–18

BATAVIA, NY The Genesee Radio Amateurs Club is pleased to announce their 2nd Annual "Wings of Eagles" Special Event Station, to be held at the 16th Annual "Wings of Eagles Airshow," at the Genesee County Airport in Batavia. Operation will be Aug. 17th and 18th between 1300 UTC–2100 UTC on 40 meters at 7.250 ± 20, and on 20 meters at 14.250 ± 20. For a certificate, send a QSL card and a 9" x 12" SASE to *G.R.A.M., Box 572, Batavia NY 14021-0572 USA.*

ENGLEWOOD, NJ The 37th New Jersey QSO Party will be on the air Aug. 17th 2000 UTC–Aug. 18th 0700 UTC; and Aug. 18th 1300 UTC–Aug. 19th 0200 UTC. Freq.: 3535, 3950, 7035, 7235, 14035, 14285. Portable and mobile operation is encouraged. For rules, SASE to *EARA, Box 528, Englewood NJ 07631 USA. Sponsored by the Englewood ARA, Inc.*

VANCOUVER, WA The Clark County ARC will host an SE Station to help the Northwest Antique Aircraft Club of Vancouver celebrate the annual "fly-in." Operation will be in the lower portion of the General class bands and on 28.450 N/T 10 meter band; plus the 2 meter band, to be announced on the 147.84/.24 W7AIA Rptr. Times: 1500–2300 UTC Sat.; 1500–2200 UTC Sun. For QSL/certificate, SASE to *CCARC, P.O. Box 1424, Vancouver WA 98668 USA.*

AUG 18

SCHAUMBURG, IL The Schaumburg ARC will operate WB9TXO 1300 UTC–2100 UTC to commemorate SARC's 20th Anniversary. They will be operating 40, 20, 15, and 10 meters up 45 kc from the General portion of the band. For a certificate, send an SASE to *Schaumburg ARC, P.O. Box 68251, Schaumburg IL 60168.*

AUG 28–SEP 2

MT. PLEASANT, IA The Mt. Pleasant IA ARC will operate WØMME 28 Aug.–2 Sep., during the Midwest Old Threshers Reunion. Operation will be in the General portion of the 80–10 meter phone bands. Visitors attending can reach the station through club rptrs. on 147.39 MHz (+600) and 444.95 MHz (+5), and are encouraged to visit the ham shack and sign the guest register. For a QSL card, send an SASE to *Dave Schneider WDØENR, 1675 Old Highway 34, Mt. Pleasant IA 52641-9580 USA*. For info, contact *NØFIB* on the Internet: *garymcme@interl.net.*

AUG 31

VINTONDALE, PA KB3BMW will be operated by the Dividing Ridge ARC 12 Noon–6 PM EDT. to commemorate the 150th Anniversary of Eliza Furnace. Freq.: 7.225/.300, and 14.225/.350. For a certificate, write to *DRARC, 199 Bender RD, Apt. #1, Patton PA 16668 USA.* 73

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

August is *not* expected to be a very good month for HF propagation, as the calendar shows. Poor (P) days are expected to occur during every week except the second. Note the rash of P (Poor) and trending-toward-Poor days each week. For best results, you'll have to try on days marked Fair (F) and Good (G), or trending between them. The remainder might be suitable for gardening, golf, or other outdoor activity. It's even possible that there will be some pretty severe ionospheric disturbances between the 23rd and 25th, so keep a sharp eye and ear tuned to weather lookouts on that weekend, as well.

An intriguing possibility that often accompanies those days marked "P" and "VP" is that when conditions are generally sluggish, these days can be followed by exceptionally *good* propagation, so be sure to check your favorite bands often and monitor WWV at 18 minutes following every hour surrounding those particular days.

Listen for forecasts with improving solar flux (higher numbers) and decreasing "A" and "K" indexes, which are indicators of magnetic field conditions and absorption of signals. Good luck with your DXing.

AUGUST 1996

SUN	MON	TUE	WED	THU	FRI	SAT
				1 P	2 P-F	3 F
4 F	5 F-G	6 G	7 G	8 G-F	9 F	10 F-G
11 G	12 G-F	13 F-P	14 P	15 P	16 P-F	17 F
18 F-G	19 G	20 G-F	21 F	22 F-P	23 P	24 VP
25 VP-P	26 P-F	27 F-P	28 P	29 P-F	30 F	31 F-G

10–12 meters

This is a daylight-only band this month, but may present openings to tropical areas as well as short-skip openings on the best days (G). During intense sporadic E conditions (rare this month), bursts of strong signals can come and go unexpectedly. Stay alert.

15–17 meters

These bands could stay open into early evening hours with possibilities of trans-equatorial DX on Good (G) days and evenings. Signals seem to peak toward the west during afternoon and evening hours. Short-skip to 1,000 miles or so should be available on many days.

20 meters

This should be your main choice for DX-chasing. Because some areas of the world are dark and others are in daylight at the same time, you can expect dawn-to-dusk, and even later, DX opportunities on Good (G) days/nights. Short-skip will prevail to about 2,000 miles during the day, and farther at night.

30–40 meters

You may find these bands quite noisy (QRN) during the daytime due to the onset of thunderstorms this month, but they will be quieter during the nighttime hours. DX to your east will be the best before midnight, and best to your west before dawn. Choose Good (G) days for the best chances of scoring a new country. Short-skip of 100-1,000 miles during the day, and 500-2,000 miles or so at night, will prevail.

80 meters

You may find that 80 meters will provide DX on Good (G) nights, limited by thunderstorm activity. It may also provide short-skip openings of 200 miles or so during the day and 2,000 miles or more after dark.

160 meters

There will be *no* daytime openings here, due to a high absorption of signals, but it ought to provide skip to 1,000 miles or so after dark. Only rarely will you find DX, and only on Good (G) nights with low or no thunderstorm activity. Low-frequency static bursts, hundreds of miles in length, limit your summer operations. 73

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14	14	7	7	7	7	14	14	21	21	21
AUSTRALIA	21	14	7	7	7	7	7	7	7	7	14	14
CANAL ZONE	14	14	7	7	7	7	7	14	14	14	21	21
ENGLAND	14	7	7	7	7	7	14	14	14	14	14	14
HAWAII	21	14	14	7	7	7	7	7	14	14	14	21
INDIA	14	14	7	7	7	7	7	14	14	14	14	14
JAPAN	14	14	14	7	7	7	7	7	14	14	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	7	7	7	7	14	14	14	14	14
PUERTO RICO	14	14	7	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	14	14	14	14	14	14	14
U.S.S.R.	7	7	7	7	7	7	14	14	14	14	14	14
WEST COAST	14	14	14	7	7	7	7	14	14	14	14	14

CENTRAL UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	14	7	7	7	7	7	7	14	14	14
ARGENTINA	21	14	14	7	7	7	7	14	14	21	21	21
AUSTRALIA	21	14	7	7	7	7	7	7	7	7	14	14
CANAL ZONE	21	14	7	7	7	7	7	14	14	14	21	21
ENGLAND	14	7	7	7	7	7	7	14	14	14	14	14
HAWAII	21	14	14	7	7	7	7	7	14	14	14	21
INDIA	14	14	7	7	7	7	7	7	14	14	14	14
JAPAN	14	14	14	7	7	7	7	7	14	14	14	14
MEXICO	14	14	7	7	7	7	7	7	14	14	14	14
PHILIPPINES	14	14	14	7	7	7	7	14	14	14	14	14
PUERTO RICO	14	14	14	7	7	7	14	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	14	14	14	14	14	14
U.S.S.R	7	7	7	7	7	7	14	14	14	14	14	14

WESTERN UNITED STATES TO:

	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	14	14	7	7	7	7	7	7	14	14	14	14
ARGENTINA	21	14	14	14	7	7	7	14	21	21	21	21
AUSTRALIA	21	14	14	14	7	7	7	7	7	7	14	21
CANAL ZONE	21	14	7	7	7	7	7	14	14	14	21	21
ENGLAND	14	7	7	7	7	7	7	7	14	14	14	14
HAWAII	21	14	14	14	7	7	7	7	14	14	21	21
INDIA	14	14	14	7	7	7	7	7	14	14	14	14
JAPAN	14	14	14	14	14	7	7	7	14	14	14	14
MEXICO	14	14	7	7	7	7	7	14	14	14	14	14
PHILIPPINES	14	14	14	14	14	7	7	14	14	14	14	14
PUERTO RICO	14	14	7	7	7	7	7	14	14	14	14	14
SOUTH AFRICA	7	7	7	7	7	7	7	14	14	14	14	14
U.S.S.R.	7	7	7	7	7	7	7	14	14	14	14	14
EAST COAST	14	14	14	7	7	7	7	14	14	14	14	14

Hey, That's Bribery!

Yeah, I know. But I want to see what's going on with your club, so if your club secretary will put me on the list for a club newsletter, I'll swap a complimentary one-year *73* subscription ($25 value) you can raffle off at the next meeting. Or use as a prize. Please address the newsletter to Editor, *73 Magazine*, 70 North 202, Peterborough NH 03458-1107. I'll also need the secretary's address so I'll know where to send the prize subscription certificate.

What am I looking for? I want to see news of new hams being elmered and licensed. And that the club is backing a member in a run for the state legislature so we'll start having some political clout and not get clobbered every time a tower restriction is proposed. I want to know if your club is giving any technical sesions on different ham modes such as packet, satellites, SSTV, and so on. I want to know about any special club activities such as hamfests, auctions, and so on. I'm always looking for good articles that have appeared first in club newsletters.

Wayne

Number 88 on your Feedback card

HAM HELP

We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full 8-1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully. A 1, for example, can be misread as the letters l, i, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

WANTED: Software for the YAESU 747 Computer Controller. Please reply to Robert Hall KC7FRY, 5314 East Linden Place, Tucson AZ 85712.

Does anyone know the address of JBI Products and Technologies? Please contact Robert Hall KC7FRY, 5314 East Linden Place, Tucson AZ 85712, and/or Joyce Sawtelle, (603) 924-0058. Thank you.

WANTED: QSLs. I took part in the WPX-contest last weekend using the signal J45DZX. Please send the QSLs to Goran Lundell SMØCMH, ELGOVAGEN 11, S-133 36 SALTSJOBADEN, SWEDEN, or via the Swedish QSL-bureau SSA.

Number 89 on your Feedback card

UPDATES

Simple Parts List Omission

In the May 1996 issue, on page 41, there was an omission in the Parts List of "Simple Multi-Use Amplified Speaker." The list should have also included:

C8 .1µF

C8 does appear correctly in the schematic diagram.

No, the *other* right

Also in the May issue, a sharp-eyed reader, Jim Farago, pointed out to us that in "Carr's Corner" on page 80, the integrator/voltage doubler is drawn incorrectly. C1 is drawn backwards in polarity and should connect as shown in the unrelated article on page 78 ("Antenna Noise Bridge Detector"): to the junction of D1 cathode and D2 anode.

U2s have a way of vanishing

In June's "Simple Inductance Meter," on page 57, **U2**, a 78LØ5 5 volt regulator, is missing from the Parts List. We regret any confusion this may have caused.

BARTER 'N' BUY

Continued from page 78

PACKET RADIO AND MORE! Join TAPR, connect with the largest packet/digital group in the U.S. Creators of the TNC-2 standard. Currently focused on Spread Spectrum. Benefits: newsletter, software, discount on kits and publications. $15/year US, $18 Can/Mex, $25 elsewhere. Visa/MC. When joining, mention *73*, receive TAPR's Packet Radio: What? Why? How? ($12 value) FREE! Internet: tapr@tapr.org; Web:http//www.tapr.org (817) 383-0000 Mail: 8987-309 E Tanque Verde Rd #337, Tucson, AZ 85749-9399. BNB4000

"QSL VIA USBURO" Info send SASE, USA QSL BUREAU, Dept. A, Box 814, Brewer, ME 04412. BNB2082

73 needs ham related photos. Call Fran at 800 274-7373.

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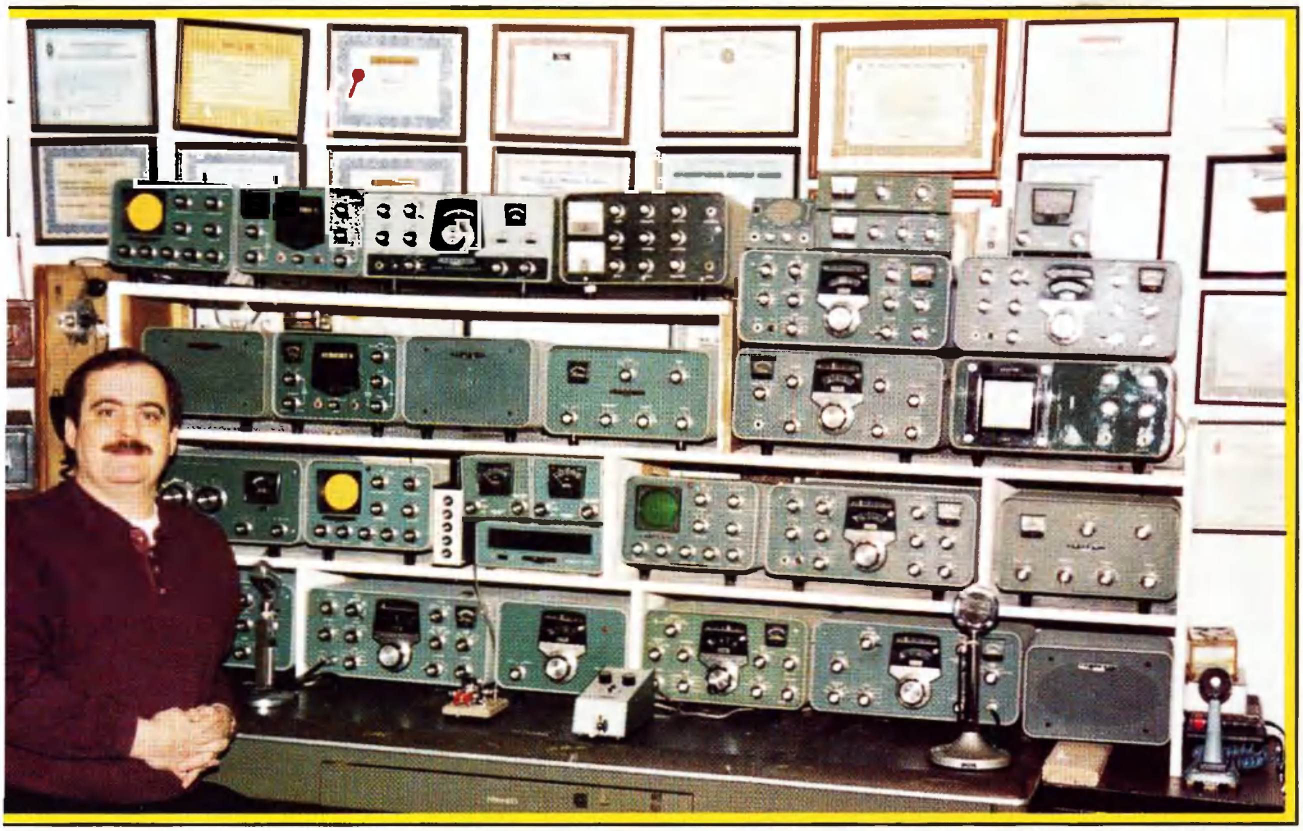
ARRL Lays An Egg

See Page 4...



Shane Brady WB2WPM and Heathkit radios

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73® Amateur Radio Today

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On the cover: Shane Brady WB2WPM with his Heathkit collection. See page 80. (Photo by WB2JFP.)

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Debacle?

I'm sure you're not going to believe that the ARRL plan to bury the Industry Working Group 2A (IWG-2A) of the 1997 World Administrative Radio Conference (WARC) in letters and E-mail from ARRL members has boomeranged, making what was a serious situation infinitely worse.

The League might have taken a hint when their initial pressures and threats were rebuffed by the IWG. But no, if a little pressure and threats don't work, let's escalate the attack. The predictable result is a very angry working group, one which is going to be even less willing to sit down and reasonably discuss the situation.

This all has to do with the potential loss of the 144 and 420 MHz bands to commercial development, as you probably know.

There is just an almost-minuscule possibility that the IW Group may suspect that the League is playing with a very weak hand. Other than rallying the blindly loyal members to send letters and E-mail, the League has few weapons for this battle they've chosen to pursue. Negotiation might have been a better tack.

The sharks in Congress have tasted blood and are eager to push for the sale of as much of the spectrum as possible. And guess which group has one of the biggest spectrum allotments? Make a second guess as to which group has the least lobbying power? Want to try for a third? Guess which group is providing the least in the way of benefits to the public in return for their use of billions of dollars of spectrum?

I see a gaping hole in human reasoning which is working to our disadvantage. Few of us seem to have any sense of the future. Most of us are so totally wrapped up in the present and past that the future, as far as we're concerned, is totally in God's hands, not ours. So we're using up the world's resources of metals, oil, coal, natural gas, and so on, and who really cares about the mess we're leaving our grandchildren? We're eating fast-food crud, drinking poisoned water, breathing air that is killing trees, and thus substantially shortening our lives. And we hams are using about 3% of our allocated radio spectrum to have fun, and little more.

Sure, rag-chewing is fun. And DX pileups are a challenge for the combative. A handful of hams are adventurous, having fun with packet, the ham satellites, SSTV, DXpeditioning, and stuff like that. Maybe 2%. The rest are along for the ride, at least until the music stops. Tomorrow? Har-de-har.

I'm still looking at every ham club newsletter that comes in, hoping to find some mention that the club is holding tech sessions to help the youngsters understand radio and electronics. I'm not finding anything.

So, go right ahead with the ARRL plan and dump on the IW Group, making them even angrier and more likely to show us who's boss. The head of the group was contacted recently on the phone. His response was unprintable. The fate of our two major Tech bands is in the group's hands, so we're busy poking him and the other the group members with a pointed stick.

The loss of 2m and 70cm could, I suspect, just about wipe out the ham industry. Again. It was 30 years ago that the ARRL wiped out the whole ham industry with a really stupid attempt to generate some controversy in order to sell more magazines. The result of this unbelievable miscalculation was that 85% of the ham radio stores went out of business within a year, and over 90% of the manufacturers blew away. Where will our hobby be if we wipe out the dealers and manufacturers again? And there's nothing like 100,000 Techs trying to sell their ham gear for anything they can get, to kill the industry. The Generals did that 30 years ago when threatened by the ARRL with the loss of their HF voice bands, and the American ham industry has never recovered.

The CB industry never recovered from their expansion to 40 channels. CB was growing like crazy, supported by movies and hit songs, and endless PR. Then, in a matter of weeks, it was dead, and most of the manufacturers were blown away.

Sneaky Plan?

A West Coast Chicken Little correspondent has suggested that the hornet's-nest reaction of the IW Group is exactly what the League planned. He points out that the ARRL opposed both the Novice and Tech licenses, and has never considered either to be real hams. Real amateur radio is the HF bands, with ARRL traffic handling nets and CW DXing. By getting rid of the 144 and 450 bands, the hobby would be purified and get back to more like the way it used to be. Remember, he points out, the League has never done anything much to help promote repeaters. That was all done by *73*.

That's an interesting concept, but I've never seen any signs of the League directors thinking two steps ahead, so I doubt the sky is starting to fall now.

Tampa, November 23rd

Are you going to be with me as I try to cram about 10 hours of information into a two-hour time slot? Please write and let me know what you'd like me to cover, because, left to my own devices, I'll deal with amateur radio: its past, present, and future. Then, if there's any interest, I'll explain the secret for making money and the shortcuts for doing it. I've lectured on this at several universities (like Yale, RPI, BU, Case Western, etc.).

Or you may be interested in the incredible developments in *cold fusion* and the opportunities that presents.

Maybe I'll explain some of the amazing things I've found out about how to keep your family healthy so they can knock our stupid Social Security tax system for a loop by living to over 100 in good health.

Education, tuitionless colleges, downsizing the government—there are lots of interesting things I can cover, if you want.

Or perhaps you'd prefer I stick 100% to amateur radio, explaining some of the ways hams win ARRL contests and awards by cheating. How about DXpeditions which weren't in the countries they said they were? I can name and give details on a bunch of those.

In the 1970s there were all kinds of opportunities to get in on the cellular telephone explosion. Then came microcomputers. Ken Olsen, the president of Digital Equipment, said in 1977, "There is no reason for any individuals to have a computer in *their home.*" Two years earlier I was predicting in my editorials that the personal computer would one day be one of the largest industries in the world. The chairmen of Data General, Radio Shack, Wang, and Centronics all told me I was wrong. So did the chairman of TI. But my crystal ball hasn't failed yet. So what do I see as coming down the pike in communications developments? Just ask at Tampa.

Maybe you'd like to hear about my plan for getting hams into our state legislatures so we'll have some political clout. I think any ham club that really wants to can get a member elected. We don't want to be like the unhappy workers who find themselves suddenly out of work when their jobs are moved to Mexico. Unless we take the bull by the horns and run with it we're likely to find our ham bands have moved to Afghanistan.

Continued on page 9

LETTERS

From the Ham Shack

Marc Yuen N6APJ. I want to let you know that your "Never Say Die" column is the best part of the magazine. I've especially appreciated your comments on health and diet. I'm also a subscriber to *Cold Fusion* and am very interested in that field. Please continue with similar content in future issues. You might even recycle some 10-year-old ones.

I suffered a detached retina in my left eye in 1994 and a year later in my right eye. Now I'm up to eight surgeries between the two eyes. Recently, I found *The Healing Power of Herbs* by Michael Murray, ND, ISBN 1-5595-8700-8. I took the recommended herb and my sight has improved to better than 20/70 from 20/200.

I'm interested in seeing construction articles about things like adapting a TV tuner module for a spectrum analyzer, radio astronomy, environmental monitoring such as seismology and weather data collection via packet radio, and such. Lately I've been too busy to pursue hobby activities, but my work is rewarding (the hardware I'm building is going to Saturn).

Well, I'm glad somebody likes my columns... Wayne.

Terry Schieler NØDFH. My friend Larry Junstrum KN4UB should be on your "famous ham" list. He's the bass player for the popular rock group ".38 Special" and a strong spokesman for amateur radio. His phonetics are "Known Nationally 4 Ultimate Bass."

Rudy Ault Jr. N2JZK. Per your list of famous hams, you forgot to include W2NSD/1—Wayne Green: educator, entrepreneur, pioneer, and man of letters. Most of the folks you listed haven't done half as much as you have. Keep up the good work.

Rudy, I'm not famous, just persistent. But amateur radio sure has provided me with a life of adventure... Wayne.

Antonio Anzevino WB2KDE. I just wanted to make a few comments about your editorial and get that list of the books you recommend. You know, at first I thought you were an old windbag, so I didn't bother to read your column. One evening I didn't have anything to read, so I reluctantly picked it up. The first book you mentioned was *The Cancer Cure That Worked.* I found this was a great book and, since then, have bought several other books you've suggested. All have been great.

I'm not the type to be idle, so I build things. Lotsa things. For instance, I have a good idea for a gadget which is really needed. I started off by contacting American manufacturers for parts in order to build a prototype. My patent attorney said to "go for it." Sad to say, I think I know one of the reasons the American economy is going down the tubes. Now I'll try and contact Asian manufacturers for the needed parts. That's more jobs that won't be available in this country.

I'm very much interested in your *Making Money*, though I really don't need to make a million since I'm comfortably retired. It's just that your column has pushed me a bit further than I normally would have gone.

I'd also like you to know that I now read your column as soon as the magazine arrives. I no longer think of you as a windbag, but as a down-to-earth guy who uses his "noodle." Thanks for pushing me into a more constructive attitude.

Glad you're enjoying, Antonio. Yep, we've not only lost our consumer electronics industry to Japan, but we no longer make the parts either. Worse, we no longer make the machines to make the parts. Heck, we no longer make most of the tools to make the machines to make the parts... Wayne.

Dan Sealy AA7OA. That Andy Griffith listed in the June issue isn't the actor, he's 20 years too young. You might want to list Paul Tibbets K4ZVZ, who was the pilot of the *Enola Gay* when it dropped the bomb on Hiroshima. And Jacob Beser W3NOD, who was the electronics specialist on that trip. Then there's Emory Gordy Jr., the OM of Patti Loveless, the singer.

I didn't see how Griffith could possibly have had time for hamming, so that makes sense... Wayne.

George Piatt N1UUN. I would like to take a moment to comment on the code requirement for General, Advanced, and Extra Class licenses. In view of the recent actions by the FCC to rescind the requirement for Morse code equipment on oceangoing commercial vessels and of the fact that the Coast Guard is no longer standing radio watch for CW communications, I think it is time for the ARRL to recognize that CW has passed its time as an essential method of communication. I will agree that CW on the HF bands will get through when QRM and QRN make other forms of communication unreadable. I will also agree that CW is an art form and a tradition of our hobby. But to set the code requirement up as a road block to the high frequency band is no longer acceptable. Fundamentally, it just amounts to "hazing."

I have no problem with making the tests more technically demanding, nor do I have any quarrel with reserving certain portions of the HF bands for CW communications, as we do now for packet and repeater modes in the VHF and UHF portions of the spectrum. My dissatisfaction derives from the exclusion of qualified technicians from the HF bands simply because they refuse to learn a language that is slow and becoming increasingly obsolete.

It must be recognized at some point that the code requirement is preventing otherwise qualified and interested amateurs from advancing in our hobby. Indeed, as time for recreation becomes more difficult to find, can we afford to demand that it be spent learning a language few people are listening to?

Troublemaker... Wayne

Jim Carson WK2K. I am writing about an article on page 90 of the June issue of *QST*, which has me deeply concerned regarding the survival of the hobby into the 21st century, as well as a secondary issue about a long-standing problem of 40m band allocations.

First, let me introduce myself briefly. I was first licensed as WV2OYY in 1960. I upgraded to General, and through the activities of an Elmer, WA2KQG, became very active in CW and phone traffic nets. It was a wonderful experience as a high school student to deliver messages from such places as the Great Lakes Naval Training Center in Michigan. After a brief lapse, I resumed the hobby in 1970 as an Extra with a home-brew SSB HF station. I am an active VE and have taught several licensing classes. One of the classes was a Tech-to-General upgrade done on 2m. My son is N2PNA. While I don't have the time or resources to pursue the hobby as much as I would like to now, I occasionally use my vintage HQ170 and Viking II. (Yes, I can still do 20 wpm.) The future of the hobby is very important to me.

I think the ARRL has done some fine work; for example, the new bands at 10, 18, and 24 MHz. I am concerned that as a group we as hams may miss an important paradigm shift and go the way of the dinosaurs, if we miss our last chance to adapt.

It is my observation that the Morse code is decreasing in relevance to the future of the hobby. It further seems unbalanced because so much emphasis in license testing is placed on this one operating mode. If this much weight was placed on another less-used mode, say, satellite communications, video, or packet, I can imagine the protest that would result. Voice transmission is the mode of choice of the majority of hams, especially if you include the bands above 30 MHz. This could change if voice evolves as a spread-spectrum or a digital mode. It is important that we adapt to the rapid changes in technology; this is not to deny the right of other hams to enjoy the "antique" modes of AM or CW if they are interested in building simple equipment. Further, considering "rights," I do not think

Continued on page 83

QRX . . .

Pitcaim island Honors Hams

The Pitcairn Island Postal Administration has announced the issuance of amateur radio stamps in honor of the role played by amateur radio operators toward the betterment of the island. Pitcairn Island, with a total of 55 people—12 of whom are licensed hams—has its own post office and postal stamp issues. The British government designs and prints the stamps, and a substantial part of the tiny (1 mile by 2 miles) island's income is derived from the sale of these stamp issues to collectors worldwide.

Pitcairn's first licensed radio amateur was Andrew Young VR6AY. Andrew's first exposure to amateur radio began back in 1922 with a Marconi crystal receiver and a simple spark transmitter that was often used to communicate with passing ships. Over the years, Pitcairn's only communications station grew as technology improved and as ham radio friends from the outside world contributed the much-needed equipment. The operators on Pitcairn have utilized amateur radio for emergency medical advice, as well as for memorable QSOs with friends around the globe, over those intervening years.

A release date of September 4, 1996, has been set for the amateur radio series, with 20 cent and $2.50 stamps, and a two-part $1.50 stamp with a price of $3.00. First Day Covers with all four stamps and the Adamstown, Pitcaim, day-of-issue cancellation are $6.20. For further information or to order the special amateur radio stamp issue, contact:

The Office of the Government of Pitcairn
(Postal Administration)
British Consulate-General
Private Bag 92014
Auckland, New Zealand

TNX Dave Miller NZ9E.

Milton Chaffee W1EFW Silent Key

Milton Chaffee W1EFW, who has been a valued member of the amateur radio community throughout most of his 83 years, became a Silent Key this past March. He dedicated his life not only to the betterment of amateur radio, but also to the prosperity of his country and community. He started his service in the Civil Air Patrol in 1942 raising to the rank of Tech Sergeant in four years. He later lent his administrative talents to councils such as his local housing authority, Chamber of Commerce, the ARRL (where he was director for seven years and Section Traffic Manager for Connecticut), and the QCWA. In addition, he held the position of ARNS treasurer for some time.

Mr. Chaffee was a man whose involvement in the world of amateur radio will serve as an example and an inspiration to hams everywhere. He will be missed by all those who knew him.

Thanks to ARNS Bulletin June 1996 for this information.

No "Hams with Class" in September *73*

This month "Hams With Class" will not appear in *73 Amateur Radio Today*. Carole Perry WB2MGP, the column's author, was not available due to a death in her family. All of us here at *73* send our warmest regards and deepest sympathy to Carole and her loved ones.

Was It Something We SETI?

Did you catch the blockbuster movie "Independence Day" yet? When the evil aliens are poised to annihilate the planet, who mobilizes for worldwide defense? Hams, of course, and with Morse code, yet. And, for those 18 people out there who still haven't seen the movie, yes, we won!

Ham Radio: Not Yet an Olympic Event

The chairman of the Olympic Broadcast Frequency Coordination Committee has announced that hand-held ham radios and scanners will be prohibited at Olympic events because of the possibility of their interfering with wireless microphones and/or live news broadcasts.

Cellular phones, though, will be allowed (as requested by the FCC) and exceptions to the ham rig ban could be made if "appropriate officials request them."

From *Newsline*; Newsline #977.

What Some Guys Will Do for a Free Beer—or K2UDP Likes His Toast Plain ... No Jam, Please

The place: Tampa.

The time: sometime between 12:00 a.m. and 11:55 p.m., May 8, 1996.

The crime: foul-mouthery over the airways and interference with emergency communications.

The motive for risking apprehension: a bottle of beer.

Two jammers for the Tampa area were taken into custody this May (one for drunk driving and one for questioning regarding interference with emergency transmissions) after operator Jim K2UDP, with the help of fellow club members, talked to them on his repeater and invited them to meet him in a bar for a beer.

After tempting the jammers by offering to sell them a stolen rig, Jim "went out to his car" and called the police, who were already looking for the jammers.

During conversations that Jim had with the jammer called Kevin, Kevin confided to Jim that he thought that amateur radio was dangerous and that "My mother didn't raise stupid kids."

At this time, the radio confiscated from the jammers is being handed over to the FCC for RF comparison with the transmissions recorded by bay area repeaters.

TNX *Newsline*; Newsline #978.

FCC License Figures

According to FCC figures, the numbers of new hams and of hams who have changed their class of licenses is up compared to the last half of 1995.

New hams for the months of January, March, and April have each totaled more than 3,000, and upgrades have topped 1,200. In February, new hams numbered 2,109, and there were 980 upgrades. During the last half of 1995, which included the Federal government furlough through the last half of December, the number of new hams averaged 2,137 per month, while upgrades averaged 811 per month. ©1996 *Amateur Radio Newsline*, from *PARKing Ticket*, newsletter of Plano Amateur Radio Klub.

Locust Grove

In 1847, Samuel F. B. Morse wrote to his brother, describing the property he'd just purchased in Poughkeepsie, New York, as unequaled in beauty and constantly changing charm. Locust Grove, Morse's estate, was to be his country home until his death in 1872. In 1901 the property was bought by the Young family, and in 1975 Annette Inglis Young endowed a trust in perpetuity to maintain Locust Grove as an historic site and wildlife sanctuary.

Today, Locust Grove is a designated National Historic Landmark, and is open to the public May 1 to November 1, Wednesday through Monday, 10 am to 4 pm. The 150-acre estate lies along a bluff above the Hudson river, with view of the Fishkill Mountains to the south and the Catskills to the north, and includes historic gardens and buildings, acres of woods and scenic walking trails to the river.

The house contains a collection of 18th and 19th century furnishings belonging to the Young family, but the main point of interest for Morse enthusiasts is the Morse collection, comprising Morse memorabilia, a model of Morse's first telegraph, and a collection of early telegraph equipment.

Morse had a telegraph line wired into his office from the main route close by, and the sound of code can still be heard at his country home. Each year, Locust Grove holds a Telegraph Weekend, during which members of the Morse Telegraph Club use authentic equipment and American Morse for a transcontinental celebration of Morse's invention; while the Poughkeepsie Amateur Radio Club operates a Special Event radio station to demonstrate International code. For more information about the Samuel F. B. Morse Historic House and Grounds, and the many events scheduled there, radio-related or not, contact Locust Grove, 370 South Road, P.O. Box 1649, Poughkeepsie NY 12601-5234; telephone (914) 454-4500.

From *Morsum Magnificat*, June 1996.

NEVER SAY DIE

Continued from page 4

Or maybe you're interested in what's going on with cold fusion and how this amazing phenomenon has forced physicists to rethink the structure of the atom. Or maybe not. Okay then, how about a recipe for some fabulous-tasting, healthy veggie dip? You'll love my "hurry-curry"—a delicious curried chicken dinner in 15 minutes.

When you write, please put "Tampa" on the left side of the envelope so I won't get it mixed with the stack of orders for my booklets which have resulted from my radio interviews. We've had to get an industrial-strength copier just to keep up with the booklet demand. It's a combination mimeograph machine and photo copier.

I'm really looking forward to the ARRL Convention at Tampa in November (23rd-24th). I particularly want to thank ARRL Director Frank Butler for his enthusiastic support, despite word from HQ that my speaking at the convention would "be inappropriate."

Dayton Bombed?

Like most (all?) other hamfests, the HamVention attendance dropped this year. And this despite the increasing emphasis on computers, which seem like they are edging out the ham exhibitors. Well, that's where the money is these days. Maybe you've noticed that some of our major ham manufacturers have cut way down on their advertising. I've noticed. But then, I'm oddly sensitive to that sort of stuff.

Can Dayton be revived? Or is it likely to go the way of NCC, CES, and other formerly mammoth shows? No, I doubt it's the new date, or any of the other excuses the HamVention Committee is using to avoid serious introspection. Our hobby has changed. It's changed a lot! With over half our hams these days essentially confined to 2m and now justifiably fearful of losing their band, the interest in special aspects of the hobby which brought many to Dayton in the past has dropped. We're seeing a drop in interest in SSTV, RTTY, moonbounce, ham satellites, and so on. It was the yearly gathering of such special interest groups which helped keep the HamVention growing for so many years.

Now, with our ranks aging, withering, and shrinking, the youthful enthusiasm which was behind the Dayton trek has dimmed. I saw few youngsters there last year. When I first started going to Dayton in 1955 the hotel was overrun with young hams. These days I have to dodge electric wheelchairs and not trip over walkers.

A side note: I've been surprised when I've talked to many of these doddering wrecks to find that they are years younger than I. Heck, I haven't done nearly as much as I could to take care of my body, but obviously I've done a lot better than most. But, you know, when I bring this up in my editorial, I get hostile letters from the crotchety old men who most need to start rebuilding their almost-destroyed bodies. Figures.

Anyway, back to Dayton. Maybe it's time to start trying some creative ideas to help bring the HamVention out of the 1930s, where it's frozen, and into the '90s. I've proposed several ideas in the past, but they've all fallen on blind eyes.

One problem for many hamfests is that they are almost all organized by hams with little experience in show business. Or even business, for that matter. They don't know how to deal with the marketing challenge. They don't know how or where to advertise, get PR (despite the availability of my admittedly superb video on the subject), attract exhibitors, and so on. None of these skills are intuitive, but it's a pity that our hobby has to bear the brunt of hamfest officials learning what they should already have known at the hobby's expense. Hamfests could be used to help recruit young newcomers. They aren't.

Hamfests *are* show business. They need stars. They need controversy. They need hoopla.

Continued on page 39

The Amateur's Guide to "Free Energy" Devices

A history, and hints for further experimentation.

Thomas M. Miller WA8YKN
314 South 9th Street
Richmond IN 47374

Any scientist will tell you that "free energy" is impossible. The law of conservation of energy forbids any device that produces more energy than it consumes. To make matters worse, the laws of thermodynamics insist that every device has loss, so no machine can produce *as much* energy as it consumes. Some is always radiated away as heat. It's impossible to break even!

"When an elderly and respected scientist says that something is possible, he is almost certainly right. When he says that something is impossible, he is very probably wrong."

Arthur C. Clarke's First Law

"Imagine that we live in a world where it rains soup, and we all have forks."

Over the years, a number of inventors have come forward with devices which seem to produce more energy than is required to drive them. Most scientists refuse to even examine these devices, and are quick to label the inventors as either lunatics or frauds. Were they to look, however, they might be surprised to find that we are not dealing with propeller-heads and con men. In fact, some of the inventors are physicists, professors, and experienced engineers, well respected (or at least *formerly* respected) in their field. But how can we believe even professionals of this caliber when their inventions violate the most sacred laws of physics?

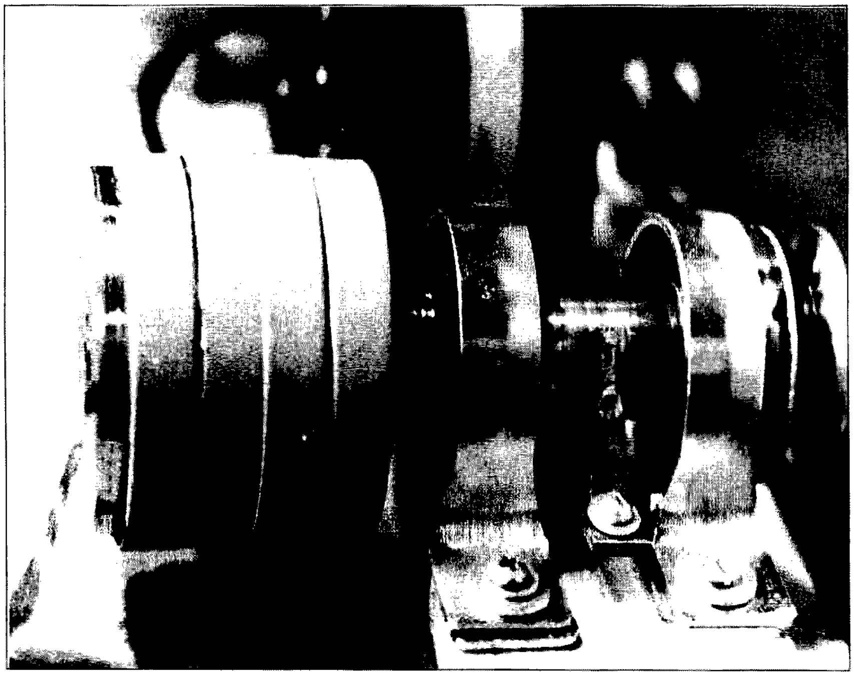


Fig. 1. Extracting free energy from ocean waves. Nature is in constant motion, providing many sources of energy free for the taking.

The truth is that these "sacred laws" only apply to a closed system. There is nothing to prevent a device from extracting energy from another source, even an *unknown* source. None of the inventors claim that their devices create energy. They just tap some energy potential in the environment.

If we can believe some disturbing rumors, some free energy researchers have experienced more than criticism and ridicule. Engineer Robert Adams claims that his patent application was denied and his invention classified under a "Military Use" clause. Not only was his device suppressed for over 20 years, but he was harassed and his life threatened! While this may be hard to believe, there are *trillions* of dollars at stake, and all the political and social power that such incredible wealth represents—certainly a motive for those interested in maintaining the status quo.

Even though many experimenters are understandably secretive about their inventions, a number of so-called free

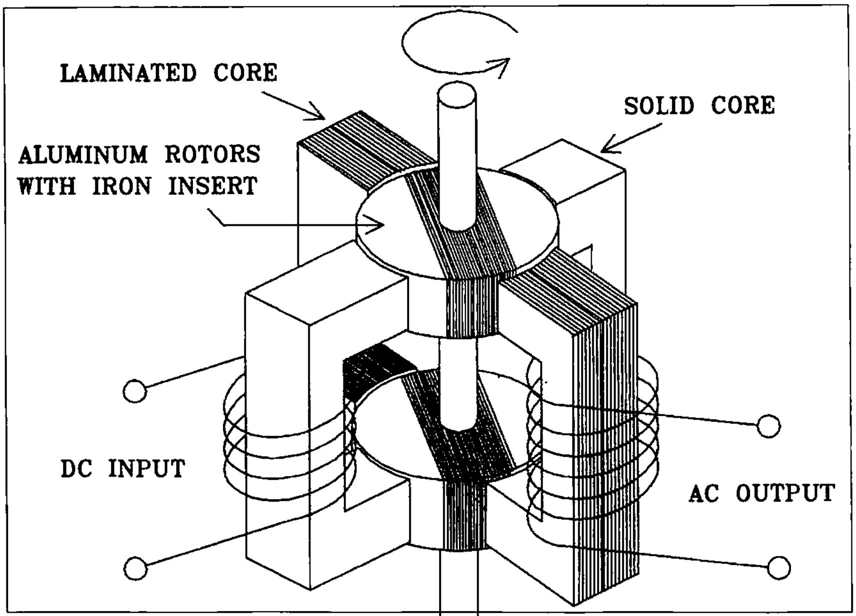


Fig. 2. The variable reluctance alternator, invented by Paul Brown, uses flux switching to convert DC to AC.

energy devices involve well-known, even patented, principles. Many of these are fairly simple, and a talented amateur with some basic electrical and mechanical skills can easily build and experiment with them. Amateur radio operators, being an intelligent and curious bunch, are in a perfect position to study these devices, and to validate or refute the free energy claims.

The universe ... a free lunch?

We cannot "create" energy. The universe *is* energy. What we perceive as solid matter is nothing more than the interaction of energy fields. Not only can there never be an "energy shortage," but there is *nothing else but energy*. All we have to do is tap it and put it to use. Unfortunately, we don't. We allow others to extract this energy and sell it to us. We meekly accept their contention that energy is very expensive to produce, and we even allow ourselves to become totally dependent upon them for our survival. The government is always planning new ways to tax energy, although when the president says that he'll tax our BTUs, you may have to rearrange the letters to discover his true intent.

Imagine that we live in a world where it rains soup, and we all have forks. A few enterprising people learn to collect this soup, refine it, and process it into bite-sized chunks. They then sell it and become very wealthy and powerful. There are always rumors of something called a "spoon," but those who know the most about soup (the soup collectors) assure us that no such thing can exist. There is, after all, no free lunch!

The truth is that the universe *is* a free lunch. Nature is in constant motion, conveniently arranged in perpetual cycles. From the twice-daily rise and fall of the tides to the constant motion of every molecule of matter, all can provide energy free for the taking.

"Even Tesla, the man who harnessed Niagara Falls, could not understand the operation of the unipolar generator."

All natural cycles have a "positive" and a "negative" portion, oscillating around a null, or zero point. For example, ocean waves exhibit crests and troughs, each time passing like a sine wave through the null point. Averaging all the waves produces zero—sea level—yet the momentary fluctuations above and below this point represent usable energy.

Fig. 1 shows a method of extracting energy from ocean waves, converting it into electricity. Such a system could just as easily operate a reciprocating pump, or do other useful work. This is a true free energy system which produces far more energy than it consumes ... free energy, not created, but extracted from the environment.

Some inventors of free energy devices claim to be able to tap the zero-point energy fluctuations in a different sort of ocean—the limitless sea of energy that underlies the universe itself.

"Zero-point" energy and the quantum field

"The only way of finding the limits of the possible is by going beyond them to the impossible."
Clarke's Second Law

A few hundred years ago, scientists accepted the existence of the "ether," an invisible medium through which waves of electromagnetic and gravitational energy moved. The ether coupled cause and effect across distances and explained wave propagation, as they observed it. Scientists expended a great deal of time and effort trying to prove the existence of ether by attempting to measure the movement of the Earth through it, but none were successful. Eventually, they decided that there was no ether, and that space was just that ... nothing at all. Electromagnetic waves moved through the void because, well ... they just did, that's all!

Today, scientists believe that the void is actually a set of energy fields which interact to form a sea of randomly fluctuating energy. Whenever this energy reaches a certain intensity, a particle of matter appears. Actually, two particles appear, one of matter and the other antimatter, since the law of conservation of energy requires that the books always balance. Usually, these particles only exist for the briefest moment before combining to release the energy that went into making them, and the cycle continues. It is interesting to note that, however intense the energy field of any single point at any given instant, the *overall* energy *cancels*. Everything, averaged together, equals nothing. Yet, just as with ocean waves, the local fluctuations of field intensity represent real, usable energy ... enough energy to create a universe.

Is it possible that these free energy devices actually tap into the ultimate source? Perhaps. Apparent violations of

accepted physical laws often lead to opportunities to expand our knowledge of the universe. Just as "relativity" replaced Newton's laws of motion, Maxwell's theories are slowly being superseded by a new electrodynamics based in quantum mechanics. So, until someone invents the science of "Relativistic Thermoquantum Electromagnetic Dynamics," we will have to do what Faraday and Tesla did—build our own hardware, experiment, observe, and make it up as we go along.

Lenzian loopholes?

"Any sufficiently advanced technology is indistinguishable from magic."
Clarke's Third Law

All conventional electric generators require power to drive them, and this driving power is always considerably greater than the total output of the generator. In other words, there is a net loss of energy. Some of this energy is lost through friction in the bearings and drive coupling, and in atmospheric drag against the spinning armature. Some waste heat is produced by current flowing through the windings and brushes, which may have several ohms of resistance. Iron cores also have resistance, and eddy currents will therefore contribute to radiated heat. Even so, the sum of all these losses represents a negligible amount of waste energy compared to the output of a normal generator. Were these thermodynamic losses all we had to contend with, electrical generation would be essentially free.

Sadly, there is another factor to consider. When we rotate the armature of a generator we cause current to flow in the windings. This current, as it flows, must create a magnetic field. The problem is an electrical principle called "Lenz's law." This law states that the magnetic field created by the flow of current will always oppose the field that created the current flow. In other words, if we drive a generator clockwise, the generated current will create a magnetic field which will try to drive the generator counterclockwise. The harder we push, the harder it will resist.

"New technology has the disturbing habit of making the impossible suddenly commonplace."

You can feel this effect by spinning the shaft of a large DC motor. Normally, the armature should turn easily, with only the friction of the bearings and the brushes to resist the rotation. However, if you short the motor leads together, the motor shaft will suddenly become very difficult to turn—perhaps even impossible to rotate by hand, if the motor is large. This braking effect is Lenz's law in action. It would also seem to have a braking effect on our search for free energy, for if Lenz's law is always true, then an "over-unity" generator is impossible.

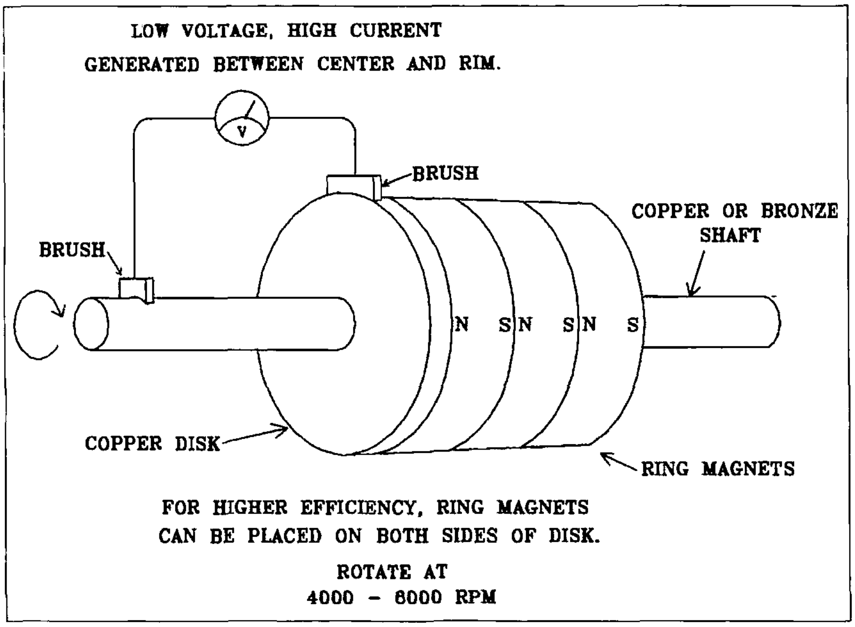


Fig. 3. Michael Faraday's unipolar generator (the "N" machine). Faraday discovered that rotating a disk in an axial magnetic field generates voltage between the center and the rim.

Fortunately, there do seem to be some loopholes in Lenz's law. While it is true that any current must create a magnetic field, and Lenz's law does predict the polarity of that field, there are a few nonconventional types of generators which do not seem to reflect this force back to the driver.

One such device is the Adams Pulsed DC motor, invented by Robert Adams, former chairman of the Institute of Electrical and Electronics Engineers, Inc. This motor uses a series of short, precisely timed pulses to energize each field magnet in succession. The field pulls a permanently magnetized armature nearly into position, then the field current is switched off. The collapsing field creates an opposite magnetic field which pushes the armature, which is by now past "dead center." As the counter field collapses, it is met by the next armature pole and another DC pulse, which starts the cycle over again. Mr. Adams has not only bypassed Lenz's law, but has in fact harnessed it!

Amateur radio operators should be able to recognize that this motor is operating in a state of resonance, and the same "flywheel" effect that we commonly see in a tuned circuit is at work here, increasing the efficiency. In radio terminology, this device is operating in class "C," as opposed to a normal motor which operates in class "A." Mr. Adams claims efficiency of over 300% in some models.

Another interesting device is Paul Brown's variable reluctance alternator, shown in **Fig. 2**. Resembling two transformer cores crossed at right angles, both magnetic circuits are opened and closed in turn by a rotating iron segment. The magnetic path for the counter field is open a good deal of the time, so efficiency is high. Some models, in fact, have shown efficiencies over 125%. Since it converts DC to AC while also acting as a step-up transformer, it should be ideal for generating 120 volts AC from 12 volts DC.

The Jameson and Kromrey motors seem to utilize a combination of the pulsed DC and flux switching techniques. It is interesting that the Takahashi scooter, which Wayne Green

described in his February 1996 "NSD" editorial, is powered by an electric motor very similar to the one invented by Raymond Kromrey in 1968. The Kromrey motor (U.S. Patent #3,374,376) uses electromagnets in the armature, while the new design by Teruo Kawai (U.S. Patent #5,436,518) uses the Takahashi super magnets for greater efficiency. The Kawai patent states that "No force opposing movement of a rotor or movable element is generated." In other words, it bypasses Lenz's law.

Fig. 3 shows another free energy device which, due to the claims made by physicist Bruce DePalma, has become the focus of discussion and controversy: the "N" machine. This generator is nothing new, since it was discovered 165 years ago. It is unique, however, since in all that time no one has yet been able to explain how it works! It is also very simple to construct—the perfect starting point for the free energy experimenter.

Faraday's "N" machine

In 1831, Michael Faraday discovered that a conducting disk rotated in an axial magnetic field produces a voltage between the center and the rim. This was surprising, since in every other method of generating electricity the magnetic field changes across a conductor, but in this case the disk is spinning in a totally homogeneous field. No change of either polarity or intensity occurs anywhere on the disk, and yet the voltage appears.

"Resisting change is like trying to put toothpaste back in the tube."

Faraday experimented with this phenomenon, and discovered another puzzle: Rotating the disk and magnet together produced the same result as rotating the disk in front of a stationary magnet. Rotating the magnet alone, however, produced no voltage in a stationary disk. From this experiment, Faraday concluded that when a magnet is rotated on its polar axis, the magnetic field does not rotate with it! He ultimately decided that a magnetic field was a property of space, somehow invoked by the magnet.

You can prove this odd fact to yourself with two small disk or ring magnets and the "peel-off" paper backing from a stick-on label. Place a magnet on each side of the paper so that they are stuck together. Now move the bottom magnet around—the top one will follow, sliding easily on the slippery surface. Now *rotate* the bottom magnet. The top one will just sit there. It will not even try to rotate with the bottom magnet. You will feel absolutely no magnetic drag to oppose the rotation of the bottom magnet, either—that's very important! It means that Faraday's unipolar generator exploits a "Lenzian Loophole." Even though Lenz's law requires that the counter field oppose the magnetic field that we used to generate the current, the fact that these fields are coaxial means that they cannot work against each other.

This phenomenon was observed by physicist Bruce DePalma in his experiments with the unipolar generator he calls the "N" machine. Spinning at 6,000 RPM, this device produced 1.05 volts at an astounding 7,200 amps, yet the power needed to drive the generator increased by only 268 watts.

Unfortunately, the unipolar generator is not yet the answer to our free energy dreams. While it does seem to bypass Lenz's law, in every other respect it is very inefficient. The electromagnet in DePalma's "N" machine consumed over 3 kW, while spinning the armature against the drag of 30 square inches of brushes required another 5 kW. The low voltage and extremely high current output from a disk rotating at high speed makes extracting the power nearly impossible, since normal carbon brushes create far too much friction, and have an internal voltage drop nearly equal to the output of the generator! A few researchers have had success with liquid brushes using mercury or even molten solder, but this is obviously dangerous and impractical.

A much better configuration was patented by Nikola Tesla in 1889 (U.S. Patent No. 406,968). Tesla's unipolar generator, shown in **Fig. 4**, consists of two disks rotating side by side, each operating in its own magnetic field. The disks are constructed with wide flanges and coupled together with a metallic belt. Reversing the magnetic field of one disk allows the two to operate in series, with the current extracted from the end of each shaft. In his experiments with this generator, Tesla noticed that when generating current, the counter

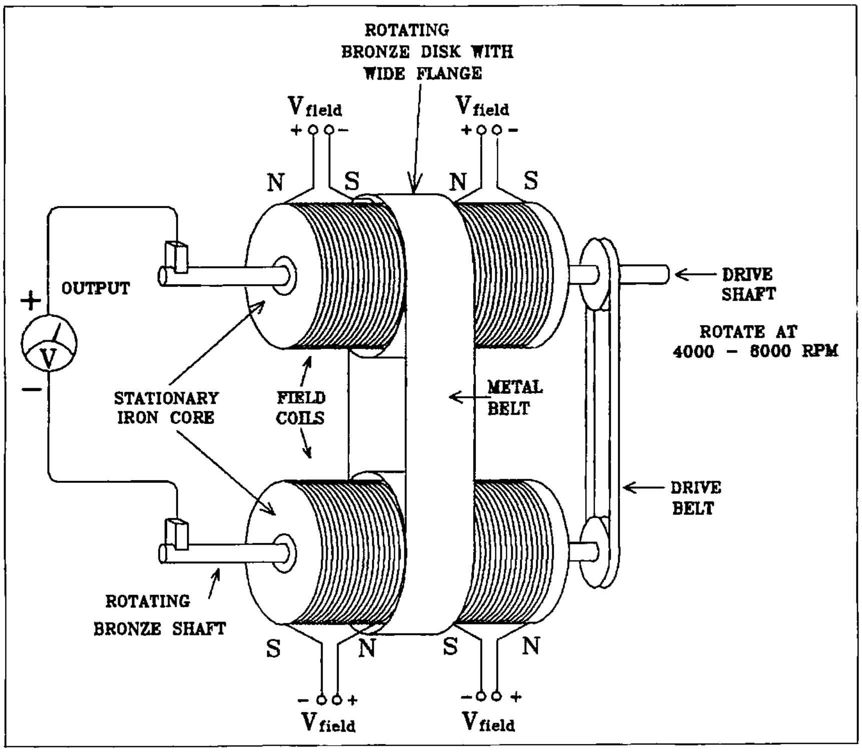


Fig. 4. Nikola Tesla's unipolar generator. Tesla made many improvements on the unipolar generator, although even he did not fully understand it.

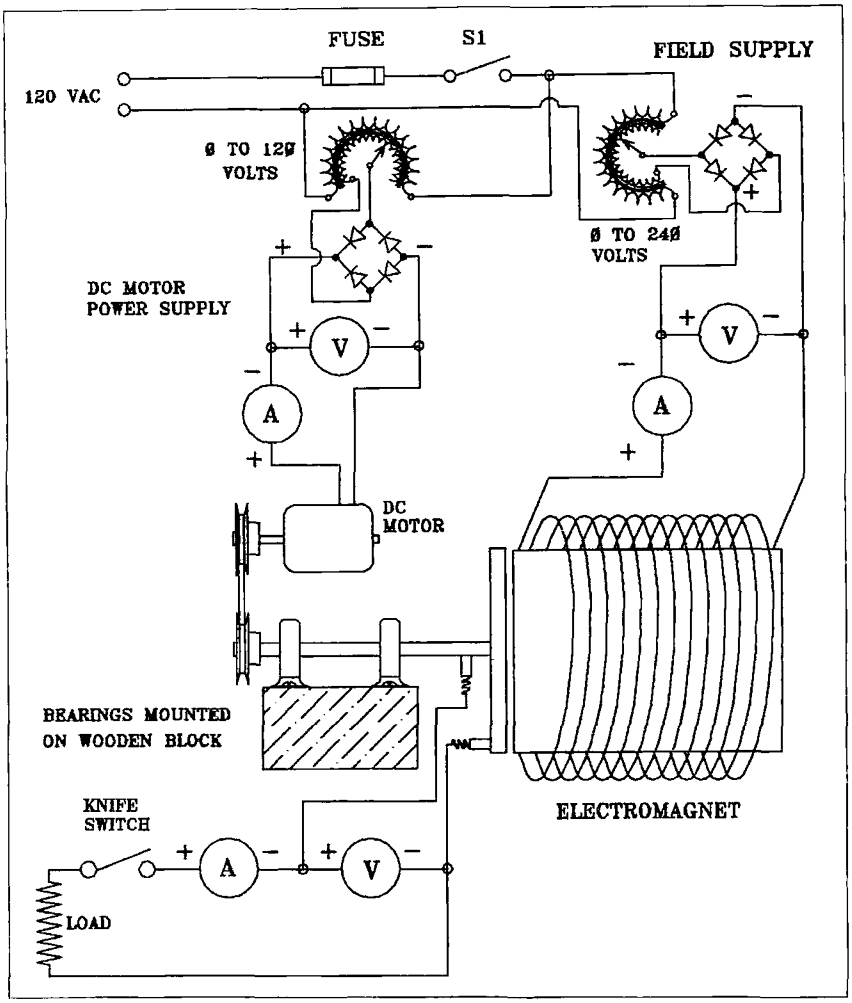


Fig. 5. "N" machine test circuit. Adjustable voltages for the DC drive motor and the electromagnet make it easier to experiment with the "N" machine.

field produced would actually *increase* the strength of the field electromagnets, to the point of eventual saturation! He proposed that, properly configured, this device could become totally self-exciting, similar to the "current accumulator" proposed by Sir William Thompson in 1865. Tesla also felt that if the solid disks were replaced with spirally-wound armatures, higher voltages could be generated—an exciting thought, since higher voltage would offset the brush losses and make the generator much more practical.

This is an area that can easily be tackled by amateurs. Experimenting with the voltage generated by different disk configurations does not require high current output, so surplus permanent magnets will work fine. Carbon brushes robbed from an old DC motor will suffice to contact the hub and rim. Disks can be cut from printed circuit board material and the various patterns etched into the copper. Does a single spiral work best, or will a double or triple pattern provide higher efficiency, much like a bifilar, trifilar-wound toroid? How about a disk cut into radial segments, like a pie? If we also split the magnet, immersing each half of the disk in an opposite field, we might be able to produce AC from this device. (Hint: Use a double-sided copper-clad disk, with half the pie-shaped elements on one side and half on the other.)

Even if the unipolar generator never becomes a practical free energy machine, there is at least one reason why amateurs should build and experiment with it: In over 160 years, no adequate theory has been proposed to explain it! Even Tesla, the man who harnessed Niagara Falls, could not understand the operation of the unipolar generator. He stated that "... the operation will be clear to us only when we shall have recognized the very nature of the forces concerned, and fathomed the mystery of the invisible connecting mechanism."

Recently, researcher Thomas Valone devised a mathematical model which explains the unipolar generator using zero-point energy fluctuations and the Special Theory of Relativity. If this turns out to be correct, for the first time amateur scientists can study a relativistic phenomenon.

Building a small unipolar generator is not really difficult, although having some mechanical skill is a plus. Steel bar stock, pulleys, belts, and pillow-block bearings are available at any hardware or farm supply store. You may even find a large solid aluminum pulley that will make a suitable disk. If you have access to a lathe, you can easily turn a disk out of brass, copper, or aluminum. The disk should be slightly smaller than the diameter of the magnets. Surplus "ring" magnets are available in the 3" to 4" diameter range, so this is a good inexpensive starting point. The output voltage is proportional to the diameter and speed of the disk, and also to the intensity of the magnetic field, so large, strong magnets are the key.

If you choose to make an electromagnet, the core can be ordinary steel bar stock, but the diameter must be at least as large as the armature disk. A coil of 2,000 turns of #22 enameled wire wound on a 4" diameter steel bar 5" to 6" long makes a good field magnet. It should draw several amps at 100 to 150 volts DC and will produce a strong magnetic field. It's a good idea to wind the coil bifilar, two wires in parallel, so that you can connect the two windings in series or parallel to match the available voltage. Be sure to cover the core with several layers of insulating tape, and also insulate between each layer of wire.

A surplus variable transformer, two meters and a bridge rectifier will make a simple adjustable field supply. You can increase the voltage slowly and watch for the point where the current sharply rises. This is the core saturation point, and you should stay well below that voltage.

An electromagnet can be made from solid stock and the disk rotated in front of it, or the core can be bored for bearings and the rotating shaft run through it. In either case, the electromagnet should

Further Information:

The Cosmic Code
by Heinz R. Pagels
Published by Simon and Schuster
Paperback edition by Bantam Books
ISBN 0-553-24625-9

Perfect Symmetry
by Heinz R. Pagels
Simon and Schuster
Paperback edition by Bantam Books
ISBN 0-553-24000-5

The Free Energy Device Handbook
by David Hatcher Childress
Adventures Unlimited Press
ISBN 0-932813-24-0

How to Build a Flying Saucer: and Other Proposals in Speculative Engineering
by T. B. Pawlicki
Published by Prentice-Hall, Inc.
ISBN 0-13-402461-3

The Anti-Gravity Handbook
by David Hatcher Childress
Adventures Unlimited Press
ISBN 0-932813-20-8

Universal Laws Never Before Revealed: Keely's Secrets
by Dale Pond
The Message Company
ISBN 1-57282-003-9

Tesla: Man Out of Time
by Margaret Cheney
Dell Publishing
ISBN 0-440-39077-X

The Inventions, Researches and Writings of Nikola Tesla
by Thomas Commerford Martin
Barnes and Noble
ISBN 0-88029-812-X

The Complete Patents of Nikola Tesla
by Jim Glenn
Barnes & Noble Books
ISBN 1-56619-266-8

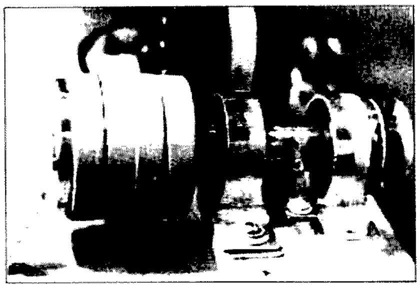


Photo A. This example of the Faraday unipolar generator uses surplus "ring" magnets and a copper disk, all rotating together on a solid copper shaft.

be stationary. At high RPMs a large diameter rotating electromagnet would probably explode due to centrifugal force.

Safety is always a big concern when rotating anything at very high RPMs since the centrifugal force at the rim is enormous. Be sure to mount a guard around the device to catch anything that might come loose, and remember to stay in front of the device, out of the plane of the armature. *Never* stand beside a high-speed rotating disk, guarded or not, and always wear eye protection!

A standard AC induction motor can be used to spin the unipolar generator at a fixed speed, but AC motors have a drawback: It is very difficult to measure the input power without some way to measure slip and power factor. The use of a DC motor will greatly simplify power calculations. A variable transformer and bridge rectifier, similar to the field supply, can be used to vary the motor speed while making it easy to monitor the input voltage and current. **Fig. 5** shows a typical test setup.

"He who controls magnetism controls the universe!"
Dick Tracy

Although many will argue that these free energy devices will never be practical, new technology has the disturbing habit of making the impossible suddenly commonplace. Breakthroughs in magnets and superconductors will certainly have a huge effect on power generation. But will that mean low-cost electricity from your local utility? Don't bet on it.

We need to remember that "practical" is a relative term. To some, practical means waiting fifty million years for dead dinosaurs to turn to hydrocarbon goo, then spending billions of dollars to pump it

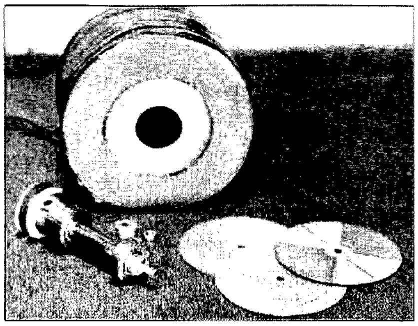


Photo B. Building the "N" machine. The shaft rotates on ball bearings that fit inside the electromagnet core. A solid aluminum disk and several experimental etched copper-clad disks are shown.

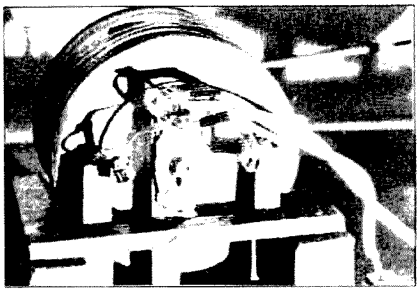


Photo C. Rotating at 8,000 RPM, the "N" machine generated two-tenths of a volt. When the output was shorted, the voltage dropped to near zero due to brush resistance. The jumper, a short piece of braid from RG-8U coax, quickly became too hot to hold.

out and refine it, finally burning it at something like 20% efficiency—poisoning the planet at every step of the process! This is obviously the most impractical system ever devised, but we are locked into it, thanks to the immense wealth and power of those who control it.

When an experimenter can build a simple device that defies explanation, it is just possible that the universe is trying to teach us something! Anomalies like this usually lead to a deeper understanding of the forces of nature, and could even launch an entirely new technology. Change can be resisted, but not for long ... that soon becomes akin to putting toothpaste back in the tube. Those who can anticipate and adapt to change will prosper. Those who cannot will eventually find themselves as extinct as the dinosaurs they now pump from the ground. 73

School's starting...nice time to give a gift subscription to your child or grandchild's school library. While you're at it, why not arrange to share some of your ham experiences with the class. Call 800-274-7373.

Quantum Theory for Amateurs

Few things are more difficult to visualize than invisible waves propagating through an intangible energy field. It is still harder to imagine that the interaction of these invisible waves makes up virtually everything in our material universe. But, since this principle will be the basis for future technology, it's well worth our time to explore it.

If we apply a source of vibrations to a point on the side of a large pan of water, we will see the energy carried away as a series of waves moving across the surface. These waves will travel until they strike the other side of the pan, then they will reflect and radiate in a new direction. Before long, the entire surface of the water will be covered with waves of the same frequency, but moving in all directions.

Whenever these waves cross one another they combine, increasing in amplitude if the waves are in phase and decreasing if they are out of phase. Since the frequency and speed of each wave is equal, the interaction between them can form a stable interference pattern. A particular point on the surface of the water will be higher or lower than the surrounding surface, and will remain that way even though the waves that contribute to it continue to move across the water. All hams are familiar with this phenomenon, since it happens when RF energy is reflected back down a feedline to interact with the energy traveling to the antenna. It's called a *standing wave.*

Just as waves move across the surface of water, waves of energy travel through the quantum field, radiating and interacting to form standing waves. The difference is that there is not one, but *four* separate fields. Energy waves from three fields combine to form *three-dimensional* standing waves. The wave pattern from each of the three fields reinforces the other two and forms a stable particle of matter, just as a triangle is the most stable geometric shape. The fourth, or gauge field, is required to keep the pattern stable as it is rotated through any axis. This ability to rotate without changing the pattern is called "symmetry," and is very important to quantum theory.

Since the particle is a standing wave, it stays in one spot while the traveling waves that contribute to it pass through. Some theorists have suggested that this causes the particle to curl in on itself, creating a vortex. This vortex action, called "spin," is responsible for magnetism, and possibly other basic forces of nature as well. Wayne Green has suggested that this spin causes a gyroscopic force that we perceive as inertia, a theory which makes sense. Inertia is not radiated by waves, and does not seem to involve the exchange of a particle, therefore it must be related to spin. There simply isn't anything else.

Multiplexed realities?

If we accept that everything in our material universe is composed of three-dimensional standing waves, then we have to accept that there is a fundamental frequency, and everything in our reality has to be composed of waves of that frequency or its harmonics. Energy of a non-harmonic frequency could also combine to create standing waves, but they would not appear to us as matter. In fact, they might not appear to us at all—a standing wave from that perspective would appear to us as a traveling wave. There could well be an infinite set of material realities occupying the same space at the same time, but out of sync with one another, each operating on a different fundamental frequency.

Now, if there are other realities overlapping our own, and if intelligent life also exists there, then they most certainly have evolved scientists, engineers, and of course, amateur radio operators. Your homework assignment is to figure out a way to *communicate with them!*

Number 20 on your Feedback card

Adventures on the Red Sea

DXing in style, in an unforgettable setting.

Carol Barsky KA9SOF
4439 Hillcrest Oaks
Owensboro KY 42303

Renting a modern houseboat equipped with amateur and marine mobile equipment offers DX excitement, a variety of experiences, and new friendships.

Beautiful beaches, crystal blue water, sunny days, and starry nights—sounds like a dream vacation in Hawaii, Tahiti, or a Caribbean island, right? There is another location about halfway around the world that offers all of the above as well as a terrific DX opportunity while living in comfort—Eilat, Israel.

Eilat, a sparkling gem of a city on the Red Sea, is situated in a unique location. To the east and west, one can see Jordan, Egypt, and Saudi Arabia, their reddish-brown mountain ranges providing stark contrast to the glittering Red Sea, which stretches to the south. It is truly a paradise for those who love to be near the water as well as to explore the vast expanse of desert that rims the city. Coral reefs attract many beautiful fish and strange sea creatures, enticing snorkelers and scuba divers. Timna Park (about 20 miles north of Eilat) provides an opportunity to hike among fascinating rock formations and archeological discoveries. Also, with proper visas, you can cross the Egyptian and Jordanian borders for further adventures.

Deluxe DX accommodations

For hams, the best way to enjoy the beauty of Eilat and the Red Sea is to rent a houseboat from Meir Globerman 4X4JP. His houseboats provide luxury accommodations at a reasonable price. Each air-conditioned boat sleeps four guests; there is one bedroom that sleeps two, and the living room contains a folding double-bed sofa for two additional guests. The kitchen is fitted with a sink, refrigerator, and stove, and the dining area seats four. A color TV and radio/cassette stereo system provides entertainment when taking a break from the ham bands (if you can tear yourself away)! The bathroom contains a toilet, sink, and shower with hot water. Two small covered decks and a sun deck allow skin cancer enhancement or conversation in the fresh air. The centerpiece for hams is the marine mobile ham station mounted at the boat's helm. The radio and vertical antenna provide excellent HF coverage for hours of pileups! My husband Rich WA1GZY and I enjoyed this houseboat/ham radio vacation while visiting in Eilat last year.

Photo A. A chat with the King. From left: Meir 4X4JP and His Majesty King Hussein of Jordan JY1. (Photo courtesy of 4X4JP.)

After boarding the boat one hot May afternoon, we pulled out of the marina. The boat's engine provided a comfortable, steady cruising speed for the catamaran-style hull and we watched Eilat become a modern skyline in the distance. Off to the east, we could see Aqaba, Jordan—Eilat's neighbor—and the beautiful mountains to the east and west that reach south to the horizon. We eventually found a spot to anchor the boat and turned on the radio. Since Israel is seven hours ahead of US amateurs on the East Coast, and since good band conditions prevailed, 20 meters provided a lot of fun. European and Middle Eastern amateurs also enjoyed QSOs with us, and one evening Rich worked stations until 3 a.m.! One of his most memorable moments was attempting to talk to a Lebanese ham. He tried to establish a contact through a DX net, but the Lebanese ham stated that a QSO was not permitted—"not even for a moment." We then remembered that our status as

Photo B. Carol KA9SOF and Rich Barsky WA1GZY near the Israeli/Egyptian border.

an Israeli station changed the expected response.

Night life can be fun ashore too. The marina is near the Laguna Hotel, and a strip of interesting shops and restaurants line the marina. Tourists flock to the area in the evening for food, friendship, and musical entertainment, and many of the other fine hotels are within easy walking distance. One evening we sat by the pool of a five-star hotel after dinner just to talk and enjoy the night sky, and we stayed until the lights were turned off at 1 a.m. All of these experiences, however, make Eilat's houseboat vacations unique and memorable—and one of the best opportunities for exciting amateur radio contacts!

"The centerpiece for hams is the marine mobile ham station mounted at the boat's helm."

A continuing saga

A few months after our return to the US, Globerman called to tell us about being informed by a friend that His Majesty King Hussein of Jordan (JY1) would be making a schedule with several hams, and Globerman was invited to join in the QSO. Not only did Globerman have the pleasure of talking to the King, but the next day, while on the Red Sea in one of his houseboats, Globerman once again met the King on the air and confirmed that he was marine mobile near the Israeli-Jordanian border between Eilat and Aqaba. Since the King was in Aqaba, Globerman received an invitation for coffee and a short visit at the Aqaba palace. Globerman jumped at the opportunity. After overcoming the red tape such an unexpected visit generates, his boat was escorted by Jordanian and Israeli maritime police, and he arrived safely to enjoy a pleasant chat with the King—certainly the highlight of Globerman's amateur radio career! Globerman's experience was even featured on Israeli television and radio and in newspapers.

The Eilat/houseboat vacation and friendship with Globerman continued to affect our lives. Soon after Globerman's visit with King Hussein, Rich was listening to 20 meters when he heard a Jordanian callsign. It wasn't the King, but Rich found that he was talking to the

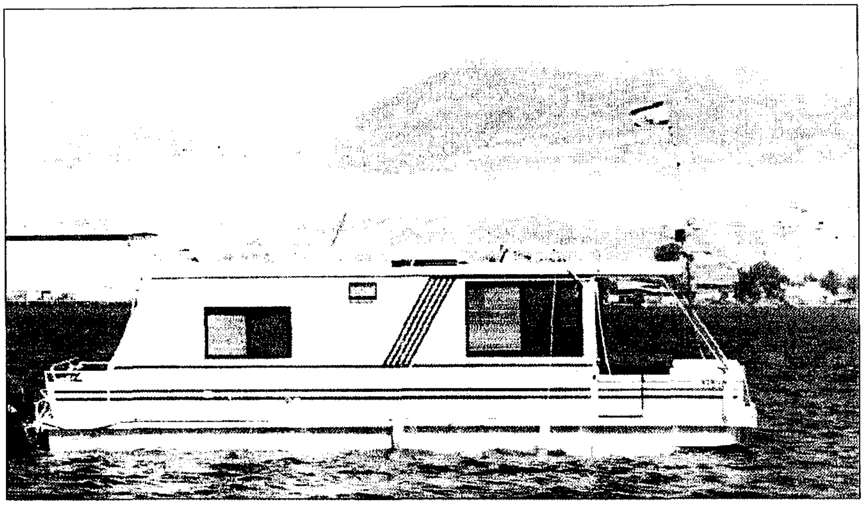


Photo C. One of 4X4JP's houseboats. (Photo courtesy of 4X4JP.)

King's pilot, JY3AK, who was flying to Washington, DC. The microphone was eventually turned over to His Majesty, and Rich made his first contact with JY1. Rich, like Globerman, basked in the accomplishment of a much-sought-after and always-treasured contact. He mentioned our vacation in the Eilat and Aqaba area, along with our acquaintance with Globerman and knowledge of Globerman's visit in Aqaba. The King said he hoped we could visit Jordan and possibly meet with him. (Unfortunately, I was outside walking our dog during this QSO and heard about it later! No, I didn't shoot the dog.)

Rich and I treasured the houseboat vacation in Eilat as a wonderful opportunity to relax and enjoy amateur radio in a different part of the world.

"A houseboat vacation in Eilat is a wonderful opportunity to relax and enjoy amateur radio in a different part of the world."

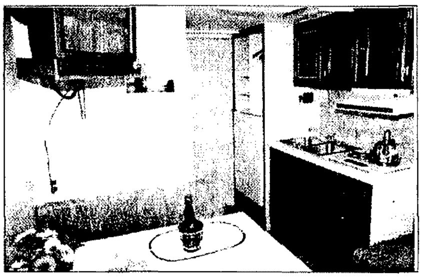


Photo D. Interior view of one of the houseboats. (Photo courtesy of 4X4JP.)

An Israeli vacation

We recommend a group tour for the other parts of Israel—especially if this is your first trip to the region. Tour guides are helpful, knowledgeable, and safety-conscious, and they provide a wonderful blend of history, religion, culture, and politics while keeping groups happy and comfortable in air-conditioned tour buses. They provide hotel accommodations in various price ranges, and breakfast is often included.

We joined a group of approximately 30 people at the beginning of our trip, saving the houseboat DXpedition for the last few days of our vacation. We enjoyed many beautiful and moving sites such as the Western Wall, Dome of the Rock, and Mount of Olives in Jerusalem, Bethlehem, Masada and the Dead Sea, Sea of Galilee, Nazareth, and many archeological sites where Roman ruins are being uncovered and reconstructed. We spent one evening at a barbed-wire-protected kibbutz in the Golan Heights, and the next morning we took a tour to learn about the residents' unique lifestyle. We stayed overnight in the beautiful port city of Haifa and enjoyed the shopping, beaches, and museums of Tel Aviv and the night life in Old Jaffa. The country offers modern shops, supermarkets, and malls, but the prices are higher than for comparable items in the US.

We're looking forward to a second trip to Israel and Jordan, and I know that one thing we will do again is venture out on the Red Sea in a blue-and-white houseboat with a small Israeli flag snapping from its HF vertical flagpole!

(At the time of this writing, houseboat rentals are $150.00 per day Sunday through Thursday. Friday and Saturday are $200.00 per day, or $1050.00 for a full week. Gas is not included. For further information, contact Globerman at P.O. Box 666, Eilat, Israel; telephone 972-7-374285; fax 972-7-373531. Operating permits are included with the accommodations.)

[Wayne's note: I don't know about the problems of taking the houseboat into Jordanian waters, but getting a ham license in Jordan is easy. I'm JY8AA. Maybe someone can overcome the bureaucrats in Egypt and Saudi Arabia and make it simple to get licenses for all four nearby countries. But at any rate, don't miss a visit in Aqaba, king or no king in residence, and then a visit to not-too-distant Petra, the lost city carved out of stone ... Wayne.] 73

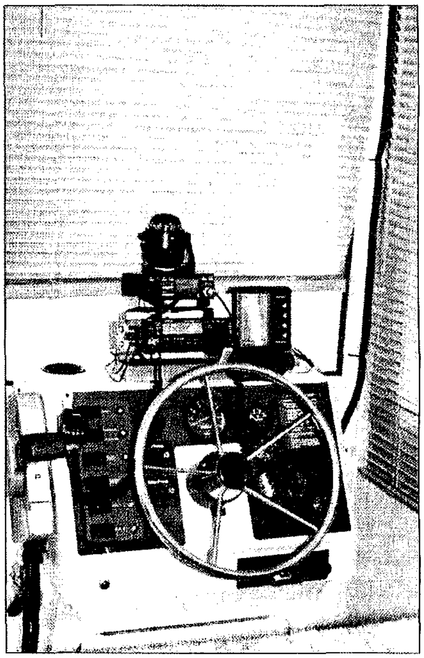


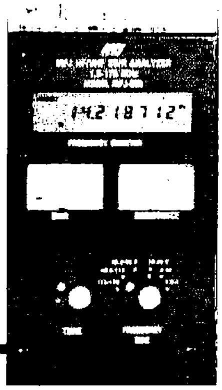
Photo E. At the helm is a Kenwood TS-50S HF band transceiver. (Photo courtesy of 4X4JP.)

73 Review

Number 23 on your Feedback card

Your Next Buy: The MFJ-259

Wait 'til you see what this antenna analyzer can do for you!



Jim Pickett K5LAD
9828 N. 151st East Ave.
Owasso OK 74055-4852

We've always been told to tune a transmitter into a dummy load, and that's a wonderful idea, but what happens when we also use an antenna matchbox or tuner? That allows us to connect our transceiver to an antenna which is not a 50 ohm load, often not even close to it. The tuner can be tuned "in the neighborhood" by peaking the noise level while listening to the receiver. The transmitter, however, must still be placed on the air to fine-tune for the lowest SWR. While this latter operation is performed, the rig is connected to a working antenna and your signal will probably be making someone somewhere cuss you out. What you need is a way to adjust your antenna tuner to a perfect 50 ohm match while keeping your signal from radiating.

MFJ has just what you need—their MFJ-259 antenna analyzer, and it covers the range from 1.8 to 170 MHz, providing a readout of both your SWR and the RF resistance, using two separate panel meters. The 259 is small enough to be used portable and can be run on internal AA batteries or from a power cube in the wall. The unit has a built-in 10-digit LCD frequency counter which provides a readout of your frequency. It has a tunable oscillator which provides a substitute signal for the transmitter. Yes, the internal oscillator, when used as an SWR analyzer, will put out a signal which can be heard by a nearby station, but it is magnitudes less than when you tune up using your station transmitter. The detector circuitry of the analyzer is sensitive enough to detect the milliwatt signal of the oscillator while the station SWR bridge expects to see from 1 to 100 watts to make it read correctly. This low power oscillator assures you'll have a non-interfering signal while you are matching your antenna.

"MFJ has just what you need—their MFJ-259 antenna analyzer."

Does it work? Absolutely! **Fig. 1** shows how I hooked up my station. The antenna switch is simply a two-position antenna switch. Several companies, including MFJ, Daiwa, and B&W, make these coaxial switches.

Actually, I replaced the switch with an old coaxial relay so I can change from Tune to Operate with the flip of a small toggle switch. You may have to shop some flea markets to find a coax relay.

To tune my rig I flip the switch (S1), turn on the antenna analyzer, and set the oscillator to the frequency I want the antenna tuned to. I tune the antenna tuner to the minimum SWR on the analyzer meter and ignore the SWR meter in the tuner, since the signal from the analyzer is so very low that these meters do not even move. I also have a manual antenna switch (S2) which switches my transceiver output to a Heath Cantenna oil-filled 50 ohm dummy load. When the transmitter is matched to 50 ohms (thanks to the dummy load) and the antenna coupler input is matched to 50 ohms (thanks to the MFJ antenna analyzer), all I need to do is set the switches so the transmitter output connects to the tuner and I know I am sending maximum output to my antenna. I haven't placed my 100 watts on the air to get tuned up yet.

By the way, just to check and see if tuning the transceiver/SWR bridge/antenna coupler combination can be improved by tuning the conventional way, I tried it. I found I was tuned up perfectly.

The MFJ Antenna Analyzer is one of most useful ham tools I've ever owned. I've used it on all my antennas, including my mobile station. With my 259 I have found resonant points where I never expected to find them. For instance, I found that the Hustler antenna, with almost any resonator, also resonates at 6 meters with the resonator becoming a trap and resonating only the vertical shaft. That's pretty handy for some of those new HF mobiles which include 6 meters.

In addition, the oscillator in the 259 is very useful as a signal generator. You say the band sounds dead? When I wonder if my receiver has stopped working on a band, the 259 provides a quick answer. The frequency counter in the 259 is also often helpful.

Remember, the unit covers up to 170 MHz, so you can check all those 2 meter antennas. It is great to have an instrument to use in setting element lengths and matching networks for antennas you're building or have picked up at a hamfest.

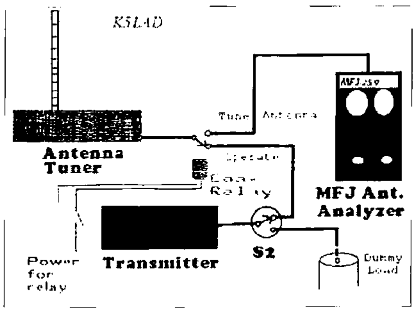


Fig. 1. Note that you can't feed the rig into the analyzer, frying it.

The Wonderful Twin-T

It's a code oscillator, a transistor tester, or even a piano. Start building!

Herbert Foster AD4UA
3020 Pennsylvania Street
Melbourne FL 32904

This little treasure has so many uses that you'll be building a bunch of 'em. It's an audio oscillator that uses no inductors of any kind. The only reactive parts are three capacitors. Add a few resistors, one of which is adjustable, and almost any transistor you have in your junk box, and you have the Twin-T circuit. It's super reliable, simple to build, and the few parts are cheap. It lends itself to just about any style of construction. It puts out a nice clean sine wave and is stable as the Rock of Gibraltar. For stability, it's almost as good as a crystal-controlled circuit, and a heck of a lot cheaper. Experimenters can have a grand old time with the Twin-T. So why hasn't it been more widely written up and talked about? I've often wondered.

It's a form of phase shift oscillator. Any oscillator is nothing much except an amplifier with its tail in its mouth. If you feed back some of the output to the input, in enough amplitude to make up for any circuit losses, and in phase with the input, it will oscillate. There's another phase-shifting circuit I've played around with that also uses a few capacitors and resistors, but the attenuation in the network is so high that the amplifier needs plenty of gain in order to get the needed amount of feedback. The Twin-T, with less loss in the circuit, does this with ease. With any given set of values in the parts of the two T circuits, at some frequency the phase from output to input will be shifted by exactly 180° and at this frequency, oscillation will take place.

The output can be taken through a capacitor of any reasonable size, .01 to .05 µF being the usual. You can connect an earphone here and get a good signal, and you can also feed this point into an amplifier circuit.

For the resistive leg of the T, use two resistors of the same size. You can start with about 39k, and a .01 µF capacitor in the T branch of that leg. For the capacitive leg, use a couple of .01 µF capacitors, but make the resistor in the T branch adjustable. Radio Shack™ sells a multi-turn pot that adjusts with a screwdriver and gives a very wide range. Buy a RS Catalog No. 271-343. It's a 10k pot with a screw adjustment that takes 15 turns to get from one extreme to the other. Any transistor that I've tried in this circuit has worked. You just need to see to the correct polarity of the power supply. In experiments I've run, 6 to 9 volts will do the job.

"Any transistor I've tried has worked in this circuit."

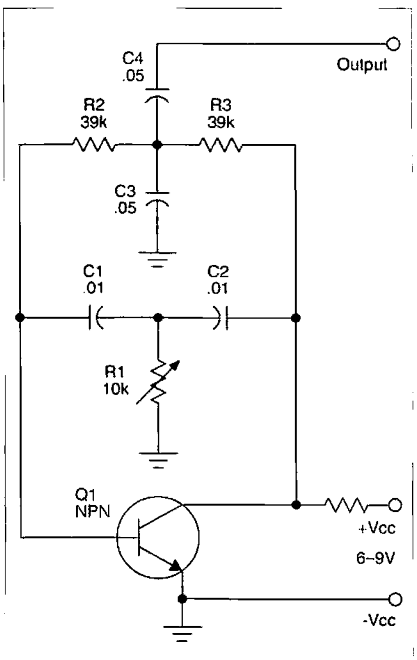


Fig. 1. Basic circuit for the Twin-T.

Although I'm showing the circuit values I've used, be sure to play around with your own values and see what you can do. You might even invent something! If you've been looking for a simple circuit with which to try your hand at making a PC board, you can't go wrong with this one.

Uses for the Twin-T

After you have your Twin-T running, and have marveled at its simplicity, it's time to consider the many uses to which the Twin-T can be put. Perhaps the first one that comes to mind is a code practice oscillator. You can build one into a very small container and fit a straight key into the hot lead of the battery. Add an earphone, and you're home free. If you'd rather have a speaker going, go back to Radio Shack and buy an Amplified Speaker System, Catalog No. 32-2031A. It runs off of four C cells or a 9-volt wall transformer.

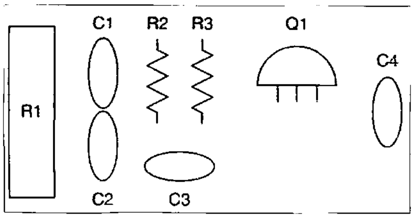


Fig. 2. Suggested parts placement on a 1" x 3" perf board. Use hook-up wire to connect the points. Place R1 so that the screw is accessible.

If you build your Twin-T on a small piece of perf board or as a printed circuit, you'll find that a small piece about 1" x 3" will take the entire circuit. This board can now be installed into the Speaker System mentioned above by simply placing it inside the enclosure. You'll find buckets of room where the small board can be placed. There's no real need to fasten it down. It will easily stand on the wires leading to the battery. Trace the positive lead from the battery holder to the ON-OFF switch, which is located on the amplifier board. Carefully tack-solder a wire to the load side of the switch, and run it through a straight key to the positive voltage input on your Twin-T board. Run a wire from the negative battery holder to the negative input on your board, or just connect that point to the amplifier's ground point; that's all it takes. If you now turn the system on, hold the key down, and advance the volume control, you should hear the Twin-T putting out a nice clean signal. You can then adjust the multi-turn pot until the frequency is satisfactory. If you are unable to reach the pitch you want, try different sizes of resistors in the T branch containing the two resistors. Just remember to use two resistors of the same size.

For another use of what you've just made, remove the straight key and replace it with a momentary contact push-button switch. Install this in the top of the amplifier case. It's a good idea to include a pilot light. Use an LED in any color you like for this. You now have a very good oscillator for use in zero beating a CW station. Set the pitch to equal the offset frequency of your transmitter. I have such a gadget right beside my transceiver and use it any time I'm up in a CW mode. I've also made copies of this and presented them to friends. They invariably like it. You will too, if you try one.

If you build this version of the Twin-T, be sure to add a pilot light in the top of the amplifier case. Without one, it's easy to forget that the zero-beater is on, and walk away to do something else while your batteries run down. The push-button switch, of course, goes in series with the battery lead to the Twin-T board. This version takes an NPN transistor.

The Twin-T will start every time, all the time, with never a miss or hang-up. This makes it ideal for a musical instrument. With such an inexpensive circuit, you can easily make a discrete circuit for each note. About two and a half octaves will make a keyboard that any kid will have a ball with. If you are also into woodworking, you won't have much trouble fabricating a piano-like keyboard. A fast trip to your local library and an inquiry into electronic musical instruments will give you the frequencies needed for your project. Or just visit any well-stocked music store and buy a circular pitch pipe. You can easily adjust the various notes in one octave by checking the aural beat note between your oscillator and the pitch pipe.

A few words about an aural beat note and how to use it might be in order here. With the oscillator working, and connected to a speaker, blow into your pitch pipe. You should hear both notes. If they are reasonably close in frequency you'll hear a rapid flutter superimposed on them. As you adjust the screw on the multi-turn pot, the frequency of the Twin-T will change, and the flutter will become faster or slower, depending on the direction of the adjustment. If your adjustment is in the correct direction, the flutter will become slower. As you get closer to the correct setting, the flutter will start to sound more like WOW-wow-WOW-wow, as the two notes join in phase to produce a maximum, or oppose each other for a minimum. If you can make the WOW-wow slow down to about once per second, you're within a hertz of the right note. Keep trying, and you'll find that you can make the wow stop almost entirely. You can beat up and down your keyboard, using the harmonics, to set other octaves.

This will sound odd, but don't try to get precisely on the frequency. If you try for high order precision and achieve it, your instrument will sound lifeless. A true pipe organ, which is the standard against which any instrument is judged, varies slightly in pitch as the pipes and tone modifiers change with humidity and temperature. Electronic organ manufacturers have gone to some amazing lengths in attempts to duplicate this slight dissonance.

Getting back to uses in the ham radio field, consider two of these Twin-T oscillators used as the required tones in checking an SSB transmitter. The big caution here is that the two tones should not be harmonically related. This subject receives a lot of attention in the *ARRL Handbook*.

Because of the reliability factor of the Twin-T, consider using it as a transistor checker. Use three short leads extending from the proper points in the circuit, terminating in small alligator clips. Each lead should be of a different color, no longer than about six inches, and marked for connection to the collector, base, and emitter of a transistor you'd like to test. You'll also need a double-pole double-throw switch to reverse the battery polarity so as to accommodate either an NPN or a PNP transistor. This can not only check the item for operation, but also determine which type it is. If a given transistor oscillates, it's good. Such a tester can even check many transistors in-circuit, as long as the circuit components are not of such a value as to swamp all oscillations. I have such a device in my tool box and consider it to be of great value. If my tester says a transistor is bad, I take it out of the circuit and test it again, before I give it the heave-ho into the trash barrel. But if the tester says it's good, I look elsewhere for the trouble.

You can let your imagination run wild here in playing with this wonderful circuit. Nothing will explode, and you aren't going to disrupt the environment. Furthermore, you don't have to own the keys to Fort Knox to finance your project. Have fun!

A Kite/Balloon-Supported Zepp for 160 Meters

Make your antenna fly high!

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Here's a way to really put out a big signal on 160 meters! Hook your antenna to a balloon for some really spectacular results. I've made a number of changes to improve the efficiency of this antenna since my article "Balloon-Supported Antennas for HF" in the September 1988 issue of *73 Amateur Radio Today*.

Efficiency without radials

Many people say that a good ground system is necessary for antennas to perform efficiently. This is not true with certain types of antennas. An end-fed antenna does require a low-resistance ground if its input (feed) impedance is low. However, when an end-fed wire antenna measures any integral multiple of a half wavelength, the input impedance is extremely high and a low-resistance ground is not nearly as important. Since a low-loss ground generally requires many radials, an antenna is much simpler, cheaper, and easier to install if its feed-point impedance is very high.

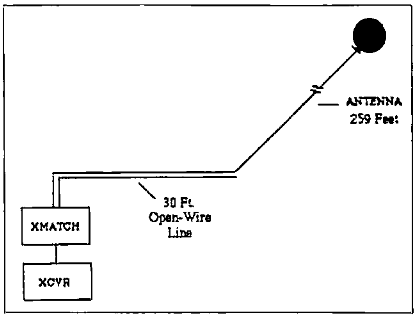

Fig. 1. Basic scheme for the balloon-supported half-wave zepp. The feedline may actually be any length; it was used primarily to get a good match with a transmatch that could not handle the half-wave antenna alone.

I chose a length of 259 feet (78.9 meters) for my end-fed wire antenna. This represents a half wavelength at 1.810 MHz. For a 160 meter contest, I planned to operate mostly between 1.800 and 1.820 MHz with the FT-101EE. Above 1.820 MHz, power must be reduced with this transceiver to keep spurious emissions under control, and 85 watts output is little enough power on this band.

I laid down two radials and employed a water-pipe (cold) ground at the station to provide a fair ground system. Using an antenna with a feed-point impedance on the order of several thousand ohms, the ground loss would be low even if the ground resistance were as much as 100 ohms—and that is a pessimistic estimate for the ground system I used.

Zepp-feed advantages

Unfortunately, my transmatch could not match the extreme impedance of the half-wavelength, end-fed wire antenna to 50 ohms for the FT-101EE. It seems the unit did not have enough inductance to accomplish this, but the transmatch did provide a 1:1 SWR if the antenna were zepp-fed with 30 feet of open-wire transmission line (**Fig. 1**). This may seem strange—that, by introducing reactance into the feed-point impedance, a match could be easier to get than with zero reactance—but apparently the transmatch could tune out reactance enough to allow the somewhat lowered resistive component to be matched to 50 ohms. It worked, and that was all that mattered to me.

With zepp feed, the bandwidth is very narrow and the tuning of the transmatch extremely sharp. I was careful to ensure that the antenna was exactly 259 feet (78.9 meters) long. I measured it with a tape measure bought just for that occasion! If the operating frequency is much different from the exact resonant frequency of the antenna, the feedline will become unbalanced and will radiate. This occurs a little bit even at resonance, but is not significant over the range of 1.800-1.820 MHz.

Zepp feed has several advantages. It can be used not only with a half-wave radiator, but also with a radiator that measures any integral multiple of a half wavelength. Also, it allows you to locate the antenna feed point away from the station. However, the SWR on the parallel-wire feeder is quite high so it is important to use a low-loss open line. Television "twinlead" is generally not good enough.

Balloons for calm or light winds

The main difference between my earlier station and the current station is the position of the antenna. In 1987 it was about 25 feet (8 meters) above the ground; now it consists of a sloping radiator with the near end at ground level and the far end about 180 feet (55 meters) above ground. The wind results in a slope of about 45 degrees with the supports described here.

The balloons I used were either 40 inches (1 meter) or 54 inches (about 1.4 meters) in diameter at maximum inflation. I got them, along with the helium gas, from a local welding supply store. I used rubber stoppers to seal the balloons after inflation. A small screw eye in the stopper provided for the connection of the antenna, using a kite swivel (**Fig. 2**).

The antenna wire is Baygard 6 electric fence wire, which is lightweight and quite strong. The conductors are aluminum so the wire has excellent conductivity and low loss. I backed up this wire with nylon twine in case the wire came loose. You don't want to have the balloon fly away with all or part of the conducting line dangling from it!

For increased stability in light-to-moderate winds, glue a disk to the stopper (**Figs. 3** and **4**). This tends to deflect air downward. I have used disks of about three feet (one meter) in circumference with success to prevent the balloon from "heeling over" and becoming nearly useless in winds of 10-20 miles per hour.

Another stabilizing method is to use a kite in conjunction with the balloon. A dime-store variety eddy bow kite works well for this purpose. The kite is flown with the balloon behind it (**Fig. 5**). It is important to attach the kite securely to the balloon. You may need a heavier bridle on the kite than if it were flown alone. Also, the kite and antenna must be light enough for the balloon to lift them when the wind dies down.

The antenna spool and safety precautions

The antenna wire and tether cord may be wound on an electric cord spool, available in most hardware stores. This spool allows rapid retrieval of the antenna and easy extension. It also provides a way of anchoring the antenna. I use a belt with extra holes punched in it to fasten the spool to a tree or other anchoring post (**Fig. 6**). A small insulator is attached at the end of the antenna to reduce end effects. The feedline is connected with a clip lead, as shown. It is important to fasten the whole assembly securely at all splice points.

There are several safety considerations that must be observed when an antenna of this type is used:

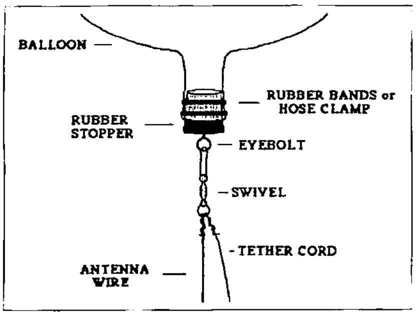

Fig. 2. Base attachment for connecting the balloon to the antenna wire and tether cord.

- The antenna must be shorter than the straight-line distance to the nearest above-ground utility line. The reason for this is obvious if you value your life!

- An atmospheric charge may develop on the wire, even in clear weather, so be careful because you can get a severe shock from the antenna wire when it is fully extended and not connected to the transmatch. A grounded wire may be used to discharge any potential before touching the wire.

- This type of antenna should never be flown during severe weather conditions or near thundershowers.

- It is best not to fly this type of antenna where it may come down on a roadway or other congested area.

- Federal Aviation Administration regulations require that a kite or balloon not present a danger to people, property or other aircraft. Further, balloons greater than 6 feet (about 1.9 meters) in diameter, or kites that weigh more than 5 pounds (2.27 kilograms), require special FAA permission before being used. (These large devices are not normally needed for amateur antennas.)

Larger kites for moderate winds

In winds gusting to more than about 20 miles per hour, balloons do not behave well, so it's better to use a kite. A good choice for this purpose is the winged box kite, or delta-Conyne. These kites are available by mail from Into the Wind, 1408 Pearl Street, Boulder, CO 80302. Other types of kites that work well are the plain delta and the airfoil or Parafoil design.

Some larger kites, especially the delta-Conyne and airfoil, will pull hard, with up to 150 pounds of tension. A strong tether line is a necessity for these kites. Also, larger kites will have sufficient pull to require more sophisticated reel-in devices than the simple cord spool. Generally, a parafoil should be eight square feet or less, and a delta-Conyne should have a wingspan of eight feet or less. This is all that is required for a half-wave or even a full-wave 160 meter antenna.

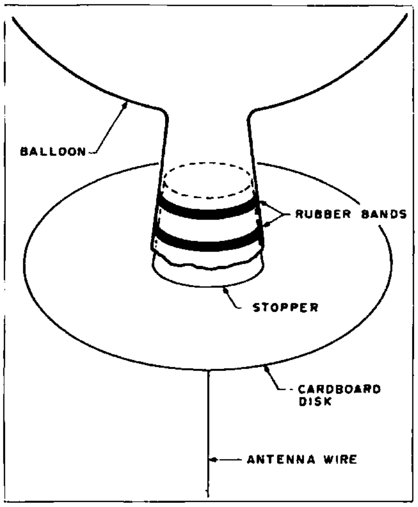

Fig. 3. Addition of a stabilizing disk for better balloon behavior in light-to-moderate winds.

For the future

The antenna at W1GV during a 160 meter contest in 1988 was what I call a "balloon sloper." On the first night of the contest, December 3, the wind was from the southwest. Therefore, the optimum direction for the sloper was toward the southwest, and the worst direction was northeast. On the second night the wind was from the north-northwest, shifting to west. The optimum direction for propagation was therefore north-northwest, and shifted to west later on.

For a domestic contest, such as a 160 meter contest, moderate-to-high angles of radiation are actually more desirable than low angles. From the Minnesota location, a north wind is less desirable than a south wind if a balloon or kite is used to support the antenna.

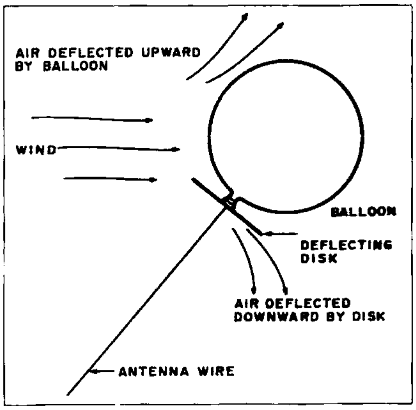

Fig. 4. The cardboard disk serves to stabilize the balloon in winds. The upward force from the disk balances the downward vector caused by air flowing around the balloon itself.

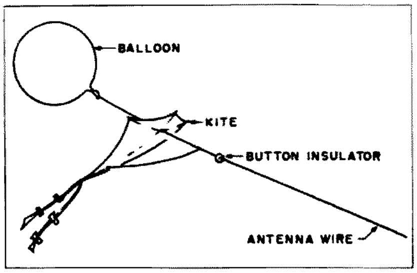

Fig. 5. Addition of a stabilizing kite for improved operation in moderate winds.

In the future, I might use another option for this method of antenna support. A full-wave wire will be held in a vertical position by guys made from 20-pound-test fishing line. This will result in a maximum radiation angle of about 36 degrees with respect to the horizon. The same feed system will be used. The antenna is shown in **Fig. 7A**, and the radiation pattern in **Fig. 7B**.

Other possibilities include flying a second wire near the driven wire to get a parasitic array. The second wire could be lengthened or shortened to render it a director or reflector. This scheme would require that the wind be out of the north or south, ideally, so that the maximum radiation would be toward the east or west.

Of course, Mother Nature has something to say. High winds, thundershowers, ice storms, snow, or heavy rain make it difficult or impossible to fly this type of antenna.

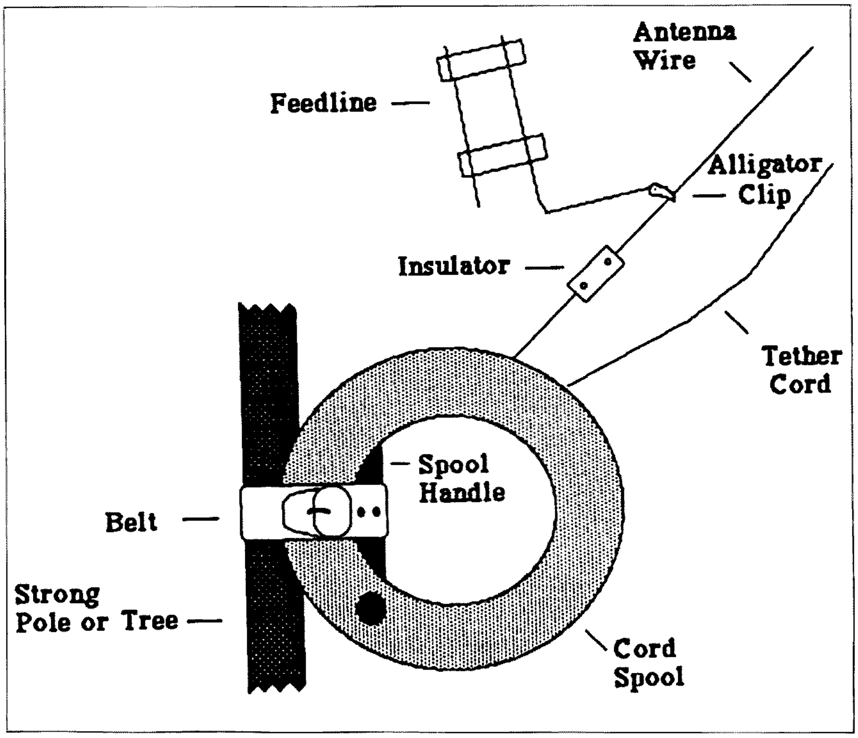

Fig. 6. The cord spool is anchored to a pole or tree using a belt with extra holes to allow it to be strapped tightly. An insulator reduces the end capacitance of the antenna. The feedline is connected with an alligator clip.

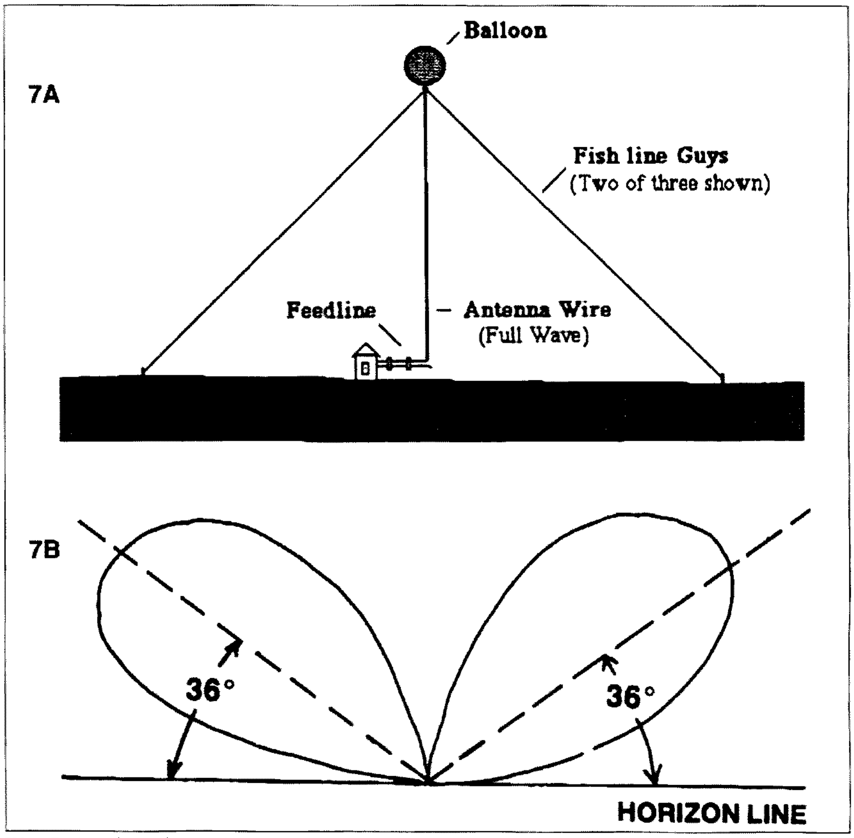

Fig. 7. A) The scheme for a vertical full-wave antenna. The height would be 530 feet for 1.810 MHz. B) The expected vertical-plane radiation pattern. The antenna would be omnidirectional in the horizontal plane and would theoretically provide excellent stateside performance from a central location such as Minnesota.

My Indoor Antenna Farm

Yes, you really can work DX with a stealth antenna.

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Radio operators of the French Resistance often used indoor antennas with satisfactory results. A typical Type B Mark II suitcase radio had a 6L6G final with an output of about 20 watts. The recommended antenna installation zigzagged wire across the ceiling to form a top capacitance. Another zigzag on the floor served as a ground counterpoise. The vertical portion that did most of the radiation was only about eight feet long.

Indoor antennas have several advantages. First, they are out of sight (my years on the TVI Committee taught me that the ham with the highest tower got the most complaints.) Second, the antennas are protected from the weather, so they can be built without elaborate waterproofing or windload requirements. And third, no dangerous roof or tower climbing is required.

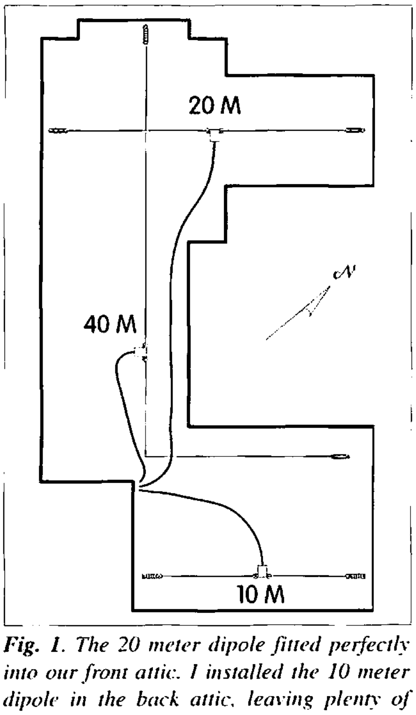

Fig. 1. The 20 meter dipole fitted perfectly into our front attic. I installed the 10 meter dipole in the back attic, leaving plenty of room for a 75 meter loop and a dipole for 15 and 40 meters.

"Tar paper, shingles, and a half inch of plywood are all that stand between my 20 meter dipole and Japan."

I prefer to have a separate antenna and tuner for each band. The antennas can then be pretuned and simply switched for band changing. My QTH is an English Tudor style house on the western slope of a hill. It has a peaked roof with a 17 in 12 slope. Only tar paper, shingles, and a half inch of plywood stand between my 20 meter dipole and Japan. The front of the house is 35 feet wide, just right for a 20 meter dipole (**Fig. 1**). In order to reduce transmission line loss, I have placed my 10 meter dipole in the back attic, right above the operating position. The dipole I use for 40 and 15 meters runs from the front of the house to the rear, then makes a 90-degree bend into the attic, where the walls are filled with insulation backed with aluminum foil. The foil-backed insulation is also laid over the ceiling, thereby insulating the attic from the living area. Of course, the unbonded aluminum foil is not a good electrical shield, so it has minimal effect on the antenna system.

What about 75 meters? A 120-foot dipole just wouldn't fit. A quarter-wave dipole fed by a quarter-wave resonant open wire line was a possibility. This was an attractive choice because the line would actually be part of the antenna, thereby permitting tuning over a fairly wide range. However, I didn't want to bring the open wire line down to the operating position. I then considered a half-wave voltage-fed loop. As in the case of a half-wave dipole, the ends of the loop would be very high voltage points. This called for the use of a quarter-wave open wire feedline. You will recall that a quarter-wave line with a short or a very low resistance at one end will have a very high impedance at the other end. In order to avoid bringing the open wire line into the shack, I used 70 ohm transmitting type twin lead for the last 11 feet. This twin lead is no longer manufactured but you could use RG-8/U instead, if you are not too fussy about maintaining a perfectly balanced line. Actually, I added 15 feet of RG-8/U between the antenna switch where the 70 ohm line terminates and my Yaesu FC-757AT antenna tuner. The VSWR at the tuner output is 3.5 at 3775, 1.7 at 3880, and 3.1 at 4000 kHz.

Number 14 insulated house wires, spaced at four and a quarter inches, were used for the open wire line. It is 45.5 feet long. The spacers were cut from one-inch PVC water pipe. The loop itself is a single run of number 14 house wire extending with numerous bends all the way from the front of the house to the back attic and back. Its total length is 146 feet. This length was determined by the reliable cut-and-try method. Due to the presence of metal gutters and chicken wire lath, all of the antennas

Continued on page 31

Off 2, 4 Good

Cheap and easy fixes for TVI.

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Though I wasn't the father of the coaxial ground, a claim to being the first cousin is in order. I honestly felt, through personal experience and feedback from many other hams, that it was the end of TVI. That was until a neighbor acquired a projection TV and antenna designed for use on Wyoming ranches in the back of beyond.

My transmitter is clean, and I always check my stuff and ask around to see if anyone has a problem. If and when they do, it's usually evident when I'm standing there talking to them—so that lets me off the hook.

It would seem that my neighbor with the projection TV had a problem. Bear with me, as it's a little difficult. Channel 2 in Denver shows rather good movies with commercials that approach the threshold of pain, but know how to stop just in time.

TVI had gone from the old days, when wiping out the channel was cause for concern, to the present, when a 10% reduction in color is enough to cause the neighbors to storm your lawn with pitchforks and flaming torches. This calls for the best effort from all of us, considering the alternative.

Hey, I've got the same problem, I hear you cry. Here's the reason and some cheap positive steps to fix it.

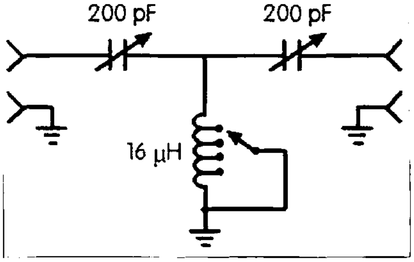

Fig. 1. The T-match.

The pi-network

Like a lot of you, I use a T-match antenna tuner—a little MFJ-943 that works just fine and is identical to almost every unit on the market. The fault with the T-match is that while it's able to load a coat hanger, there is almost no harmonic attenuation, which I need to protect my neighbor with the sensitive TV. I use a modified G5RV, a 102-foot dipole fed with 300-ohm twinlead. Really, all you need with a resonant antenna is a line flattener. Using a T-match is overkill when a pi-network will do. In addition, the pi-match gives up to 30 dB of harmonic attenuation and tunes very smoothly. Best of all, it's easy to turn your T-match tuner into a pi-match device.

Fig. 1 shows the schematic of the T-match, listing some common values for the coil and caps. **Fig. 2** shows a pi-network that takes about 45 minutes to accomplish with your existing T-match tuner—the only parts needed are a couple of plastic parts drawer dividers to place under the inductor after it's lifted from ground. The capacitors "float" in a T-match, so all you have to do is reconnect the input wire to the output wire and ground the other terminal to an existing chassis point on each.

The lifted ground on the inductor goes to the output lug on the second capacitor. In most cases, the ground wire, if you're using a tapped inductor with a rotary switch, is the one to be rerouted to the output capacitor. **Fig. 3** shows the whole modification, which is easily reversible should your circumstances change. You've just spent 45 minutes, and reduced your potential harmonic output by 30 dB.

Harmonic attenuation

OK. You're using a T-match, and the antenna is a squirrel. What to do? There's an old chestnut that calls for a capacitor of about 5-12 pF to go from the center of the "T" to ground for harmonic attenuation. The problem is that this high "Q," consisting of the capacitor and leads, is resonant *somewhere*—usually not in the area of interest, and about as sharp as a knife as far as bandwidth is concerned.

A check with my Heath solid-state dipper while transmitting on 10, holding it against the twin-lead coming out of the tuner, did indeed show a little something at 57 MHz. A few milliwatts, to be sure, but that's all it takes! The TV signal is far down from this in a fringe area!

What I did was to make a simple series trap out of junkbox parts; that cured the situation completely. A broadband trap lets me absorb the harmonic completely, and is tunable over a small range. There are a few pitfalls, so I'll tell you exactly how to do it and why.

The cure

Wind a coil of about five turns of #20 solid insulated wire around a roll of dimes (or something of similar diameter), close-spaced (about 0.8 µH). Coat it with DuPont Duco™ or model cement, and let it dry for several hours.

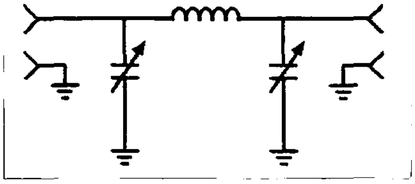

Fig. 2. Pi-match.

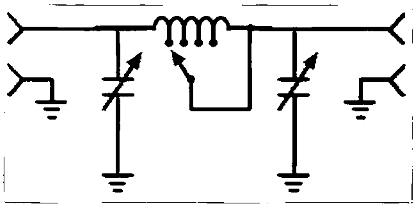

Fig. 3. "T"-to-"Pi" match.

This is a good time to scrounge the parts. You will need a compression mica, a glass piston or small air variable capacitor with a value of about 5-25 pF, a 0.001 µF disc capacitor at 1 kV or higher if running more than 100 watts, and two 100 ohm, 2 watt resistors. These are assembled as shown in **Fig. 4**, with the two resistors in parallel, to make a 50 ohm load to absorb the harmonic. Just shunting the little devil to ground won't cut it, as all you've done is attach it to the chassis of the tuner to radiate in fine style.

The procedure is quite logical. While transmitting on 10 meters, using a dummy load if possible, hold the dipper coil near the trap coil and adjust the capacitor to null the harmonic out. It isn't terribly critical as the Q isn't sky high—on purpose. It's sacrificed for a bit broader bandwidth. This may be done with someone watching Channel 2 if you don't have access to a dipper. In my case, after I had done this, I put the dipper coil into the tuner inductor and checked from 50-250 MHz to see if there were any more snakes in the grass. If there were, they were hibernating.

Proper grounding

What the heck is a coaxial ground? It's simply a method of shielding your ground cable, so any signal radiated off the ground wire is shunted back to ground. Despite having been printed in four publications at least six times, many hams have never heard of it. These hams are also the same fellows who have monster RFI problems, while the local "experts" drink all their beer and tell them it's one of nature's unfathomable mysteries. The first thing these poor souls tell me is that they are *positive* every item in their shack is grounded! I don't doubt that a bit.

If manufacturers really wanted to save a little money, the ground connection on accessories would be a great place to start! What that little double-nutted screw on the back of an audio filter, or that #2 copper battery braid, does is set up ground loops that let your RF have the time of its life!

The *only* thing you ground is the *RF generator*—meaning the transmitter or receiver—*not* the linear, tuner, rotor box, preamp, low-pass filter, keyer, phone patch, EXT, VFO, AUX, or the dog. To use the water analogy for RF: *Keep it in the pipe (coax) and let the coax shield do the grounding automatically!* This is so obvious that no one does it.

To make a coaxial or "zero length" ground, you just need two 0.001 µF 1kV disc capacitors and enough RG-8X to reach from your rig to the ground rod, which should be at least six feet, driven next to the foundation where moisture is retained. Using a stainless steel worm-driven auto fuel hose clamp, attach the bypassed center conductor of the coax to the rod. Waterproof it with glue, caulk, or acrylic spray. It doesn't matter if you're on the third floor; the ground length is still very short—just a matter of inches. The other end goes to the RF generator. That's the only ground connection you use (see **Fig. 5**). Use any or all of these methods in combination, and you'll definitely be off Channel 2 for good!

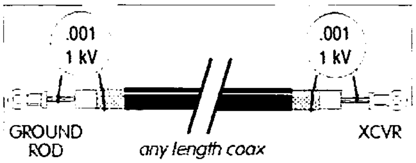

Fig. 5. The coaxial ground.

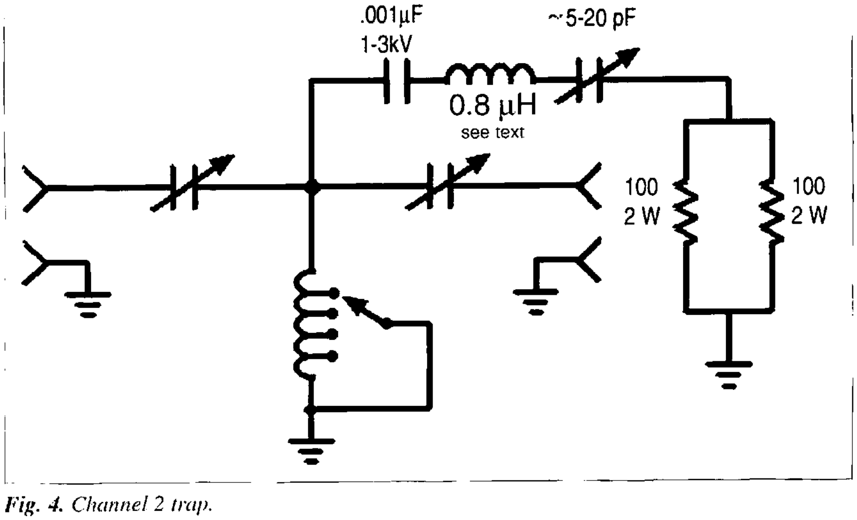

Fig. 4. Channel 2 trap.

My Indoor Antenna Farm

Continued from page 29

required pruning. The metal in the structure also detuned the 40 meter dipole, making it difficult to find the electrical center of the antenna. TVI has not been a problem. The small amount of interference introduced by the 20 meter antenna over the family room was quickly cured with a high-pass filter on the TV set itself. The only place where I haven't been able to cure the interference was with the burglar alarm. The sound of sideband audio emanating from the speaker is annoying, but hasn't damaged the unit or affected its operation.

Of course, the indoor loop is not as effective as a full-sized outdoor dipole. It is, however, just fine for working southern Oregon from San Francisco. My friends in Japan and Australia may be interested to know that this was the 20 meter indoor dipole I used to work them with my 20 watt MOSFET amplifier (References 1-2). It just goes to show that a resourceful ham, like the members of the French Resistance, can still make important contacts while keeping a very low profile!

References

1. Vreeland, Robert W., W6YBT, "Transformerless Amplifier," *73 Amateur Radio Today*, August 1995, pp. 48-54.

2. Vreeland, Robert W., W6YBT, "More Gadgets for your MFJ-9020," *73 Amateur Radio Today*, October 1993, pp. 10-12.

Number 32 on your Feedback card

73 Review

TD-3 Subaudible Tone Decoder Module

Hamtronics' kit saves one club's treasury—and provides a group project!

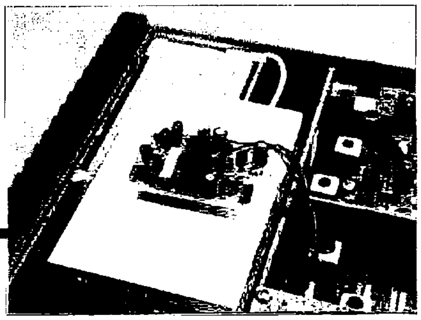
Photo A. The assembled TD-3 Encoder/Decoder ready for final installation in the repeater chassis.

Larry R. Antonuk WB9RRT
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Marlborough NH 03455

Our ham club's simple repeater system had been in service for almost five years. It was just a basic controller, with a CW ID, hooking together a couple of converted commercial mobile rigs. The duplexer was whipped up by a couple of the guys in their machine shop. We had pooled our money and come up with enough to buy a real antenna and had talked the cable TV guy into letting us have some space on his tower. Overall, it was a good machine—it rarely needed service, and covered all of the area we were interested in.

The trouble started one winter. We noticed the thing keying up by itself every once in a while. Mostly noise, but now and then you could almost make out a voice. We checked the repeater from one end to the other—everything was right up to spec. The noise got worse until it got to the point where several of the locals were no longer monitoring the repeater frequency—it was just too irritating. Even the RACES guys turned their scanners off at night. Eventually, we were able to make out a callsign or two—from another state. It wasn't just squelch noise we were hearing. The repeater was being keyed up by very weak signals from another distant repeater system.

But wait a minute! These guys were operating on *our* frequency! We were coordinated! As it turned out, *they* were coordinated, too. It was only when some of the mobiles were transmitting from the peaks of high hills that they were just strong enough to key up our machine.

"But wait a minute! These guys were operating on *our frequency!*"

Finding a solution

Once we knew what the problem was, the solution was simple. At the next monthly club meeting, a proposal was put forth. In order to keep our machine usable, we had to eliminate the noise problem. Obviously, the best way to do that was to add a subaudible CTCSS (continuous tone coded subaudible squelch) tone decoder to the repeater. This tone, commonly referred to as PL (private line), would be used to gain access to the system. All the users would have to do was to dial this tone into their synthesized rigs, and they'd be all set. A show of hands, and the proposal was soundly defeated.

Wait a minute! Another show of hands, and the reason became obvious. Only about 10 percent of the active users had rigs that had PL capability. Most of the group had older synthesized rigs, and some still had crystal rigs. No one was willing to shell out the bucks to add a PL encoder to his radio, since they weren't really going to get any immediate benefits from it. The proposal was shelved until the next meeting.

Over the next week or two the problem was kicked around, and a new idea came up. What if those other guys already had PL on their system? We could just set up our repeater to *not* repeat when it heard their PL. Since our signals were always stronger, it wouldn't matter if they were on the air when we were transmitting. Our non-PL signal would just override their weaker PL signal, and the repeater would kick in. It seemed like a good idea, and after a few phone calls it turned out that it would work. The other repeater definitely used CTCSS decoding. All we needed was a PL decoder for the repeater.

Hamtronics to the rescue!

At the next coffee shop meeting of the Technical Advisory Board we looked over the specifications on the various CTCSS decoders. We had several requirements—quality, dependability, ease of use, and customer support. Since the club had an abundance of technical ability and a shortage of funds, we considered building the unit ourselves, but the most cost-effective solution turned out to be the TD-3 Subaudible Tone Decoder/Encoder Module from Hamtronics. The TD-3 was available as a low-priced kit, which made the treasurer happy. It was based on the time-tested NE567 IC, using a straightforward circuit, so there were no custom chips to worry about if it ever needed troubleshooting. It had a built-in encoder, so when the day came that we had to switch over to genuine "PL" operation we'd only have to move a couple of wires. Best of all, the TD-3 was backed by the folks at Hamtronics—we were all familiar with their history of customer support. We gave the information to the treasurer, and he put a check in the mail to Hamtronics.

A week or two later the UPS truck dropped off the TD-3. That Saturday we met at the shop to build and install the unit. We opened the box and found just what we expected from Hamtronics: a high-quality glass-epoxy circuit board, high-quality parts, easy-to-follow instructions, and plenty of set-up and troubleshooting tips.

The board was finished in about 45 minutes, even with the "help" of three kibitzers. Testing and checkout were simple. We had access to a frequency counter, so we simply needed to hook the counter up to a test point and adjust a pot for the right tone frequency. The TD-3 covers any frequency in the CTCSS band, from 63 to 250 Hz, in six different ranges. The proper range is set by changing the value of a resistor connected to the NE567. Once the unit is set to the right frequency the sensitivity is adjusted. This is simply a matter of adjusting a pot until a signal with a minimum amount of tone (we used 200 Hz deviation) can be detected. Normal CTCSS systems like to see anywhere from 300 to 600 Hz of deviation. Adjusting for slightly less than the minimum value lets you accommodate radios that may be a little out of alignment, without being so sensitive that the unit falses on voice audio.

"The board was finished in about 45 minutes, even with the 'help' of three kibitzers."

The results

Once the TD-3 was assembled and tested, we went to the hill. The TD-3 was designed for use with the Hamtronics line of repeater controllers. It normally inhibits the COR signal from the repeater receiver, preventing repeater PTT until the TD-3 hears the proper tone. In our case, we needed just the opposite: We needed to inhibit PTT when we *did* hear the proper tone. This turned out to be a relatively simple task. The TD-3 uses an open-collector output transistor that goes low when no tone is detected, keeping the COR line low. Rather than using this on the COR line, we simply lifted the ground on the last PTT transistor before the transmitter and connected it to the open-collector output on the TD-3. The repeater operates the same as before, except that the ground for the PTT switch transistor comes from the TD-3. If the TD-3 is not detecting the proper tone the open-collector transistor is turned on, which grounds the output. This ground is fed to the PTT switch transistor, which puts the repeater into transmit. If the TD-3 is able to detect a tone, however, the open-collector transistor opens and removes the ground reference from the PTT transistor, which prevents it from keying up the repeater.

As a final check, we put the repeater on the air and ran some tests with mobiles and handhelds in our area. We found that even when the repeater was inhibited by a distant signal, a local handheld was able to overpower the weaker signal and hold the repeater on without any dropouts or flutter. The operation was a complete success!

The TD-3 has been in service for quite a while now and has survived lightning strikes, power surges—and a small family of mice that moved into the repeater cabinet. We saved a good deal of money by building it ourselves and are fully prepared for the inevitable day when we'll have to switch over to conventional CTCSS operation. Most importantly, the repeater is quiet. If we hear something, it's a legitimate user using the system. The RACES team is once again monitoring the local channel. The TD-3 Subaudible Tone Module comes highly recommended.

For more information, contact Hamtronics, Inc. at 65 Moul Road, Hilton NY 14468-9535; phone (716) 392-9430.

FRACVERT: Small Fractal Footprint Vertical

Fractal counterpoise, or top hat too!

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Ground planes and counterpoises seem to be one of those dark areas of knowledge for most hams. Here's a good rule of thumb: Only a few radials (most people use 1/4 wave) cause a radiating counterpoise (bad news); lots of radials make the vertical give off most of the RF (good news). Ultimately, an infinite ground plane is the best situation as it affords additional gain; however, for that, you can dream on.

I've been impressed by some of the weird ways that HFers have accommodated the ground counterpoise problem for HF and MF. Europeans seem particularly vexed by this problem since they usually have small lots, and all seem to want to get on 160m and work W6s. Their radials are turned sideways, in hairpins, twirls or pretzels, or whatever. They seem to take up the entire lot. I'm not sure if these are genuine solutions; you might be able to get these counterpoises to match for 50 ohms, but chances are they radiate badly (that is, very well)—and into the ground itself.

"The radiation resistance of this vertical is higher than a conventional system, hence the better SWR and bandwidth."

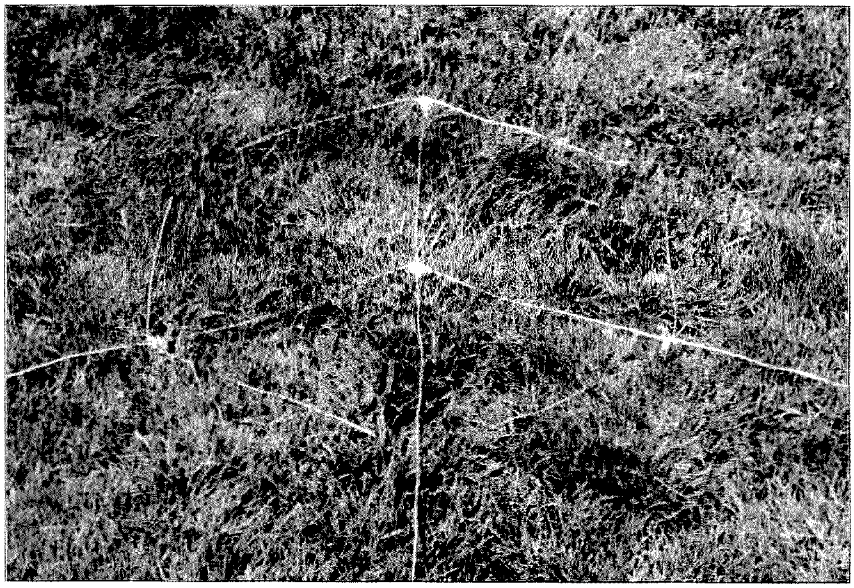

Photo A. The author's 20m version of a fractal counterpoise; like a spiderweb, it's not as fragile as it appears.

Try fractals

Fractals have provided a worthwhile answer. Here I present a radical radial counterpoise which appears to have all the benefits of a multiple (a dozen or more) 1/4-wave radial system. But it takes up less than 1/20 of the area. For those who want the NEC simulations and more technical details, these can be found elsewhere.[1] For now, here are simple details for making such a ground for HF verticals.

Technically, the fractal pattern of the radial ground counterpoise is called a "third-order ternary dendrite," as shown in **Fig. 1**. The vertical is attached at the center where the three primary "branches" meet. I made my counterpoise out of thick aluminum ground wire, then twisted and crimped the wire and covered it with aluminum tape. Many prefer to solder it (good luck soldering aluminum!). Copper wire is a good substitute, and easier to solder.

Electrically, the fractal counterpoise is equivalent to a lumped circuit of series/parallel-connected capacitors/inductors. The branching replaces the usual parallel arrangement of having many radials. In hindsight, it seems strange that branching hasn't been a well-known (if known at all) alternative in ground

counterpoises. Fractals provide a natural alternative solution to a counterpoise's equivalent circuit.

The fractal pattern is important, although a pinch of deviation will give negligible degradation. If you want to scale all the lengths properly, keep in mind that the system can be viewed as branches with branches with branches.

There are three primary branches that start from the center and form the outermost extents. Each of these is 0.088 wavelengths. Use a ruler to scale the others as needed, and at your frequency of choice.

For my 20m version, shown in **Photo A**, the longest branch (there are three of these) was 5.8 feet. Compare this to the 16.5-foot lengths of conventional spoked radials for 20m and you can see the huge real estate savings. The counterpoise was on the ground, although it should work equally well when buried, or even better when raised a few feet above ground. If you're using a ground rod without radials now, this is an easy way to beef up your ground system. Unless you live on a postage stamp, this means you can now put on radials for a 40m or 80m vertical in a small lot. All you need is the vertical itself.

Speaking of the vertical, there is a minor change. Instead of being 1/4 wave long, it needs to be lengthened to 0.3 waves. On 20m that means increasing the length by 2.5 feet. The change is easily accommodated by a coil if needed on 80m or 160m.

Performance

How does it perform? In a comparison test with a 20m vertical with four radials of 1/4 wave, it seems to have an S-unit (the mythical 6 dB S-unit) edge. This is higher than modeling would predict; it should make much less than a 1/2 S-unit difference, mostly because of the higher radiation resistance and less horizontal radiation from the fractal counterpoise. No matter; it works better, in addition to being smaller. It's comforting to know that less RF is going into the ground, heating the air, or worse. Incidentally, the bandwidth (2:1 SWR points) is a broad 700 kHz at 14.2 MHz center. Minimum VSWR is 1.3:1. The radiation resistance of this vertical is higher than a conventional system, hence the better SWR and bandwidth. The VSWR shows that the ground losses are minimal.

Some experimenting is still in order to see how well the fractal counterpoise works as a multiband system. Some quick checks show that a 30m counterpoise works on 10m, but I don't know yet if it radiates (sure don't want it to!). Experimenting is needed; new fractal territory ahead!

"You can now put on radials for a 40m or 80m vertical in a small lot."

It *is* possible to make very small counterpoises and still have good verticals—but they need to be made 1/3 wavelength in height or more. A solid circle of the fractal's radius also works well at the dimensions given here. But at much smaller radial sizes, the fractal seems to have an advantage with a higher radiation resistance and bandwidth. This present combination provides an easily-made counterpoise with excellent 50 ohm match, but if you want a really *tiny* footprint, just shrink the fractal counterpoise and increase the vertical!

Top hats

Finally, you may have noticed how verticals are getting turned upside down these days, with huge radial-like top hats capping them off. Top hats are a very old idea, and a very good one because they allow you to shorten the vertical height by about a factor of two or more. The radiation resistance drops to about 20-25 ohms (from 35 ohms), but for most of us that's not a problem; good efficiency is still attainable.

Top hats themselves don't radiate (much), and shouldn't. This is not their problem; their size is. Typically top hats run up to 1/4 wave. That's huge!

A more modest "cap" can be made using the ternary fractal. Placing the fractal at the top of the short vertical allows it to be matched. I am not a big fan of top hats, but for those who need them (160m-40m ops), the conventional top hat can be replaced with a ternary fractal cap (or other fractal). A direct comparison for several different sizes shows that for a given vertical electrical length and top hat comparison, size savings of 20%-50% are typical. Again, a bit of experimenting pays off. **Fig. 2** is a schematic of a 1/8-wave vertical with a ternary fractal top hat, next to a 1/4 wave. It provides almost equal performance. For the truly brave, there's a fractal hat and a fractal foot—but that's a subject for a later paper.

Jazz up your vertical with a ternary fractal counterpoise or top hat. Either way, the size savings will be substantial, and you'll have the most radical radial antenna around.

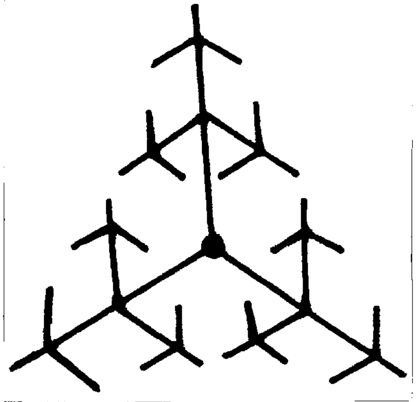

Fig. 1. *The fractal pattern of the radial ground counterpoise, called a "third-order ternary dendrite."*

Reference:

1. Cohen, N., "Fractal Antenna Gallery," *Communications Quarterly*, Summer 1996. Aspects of this work are patent pending.

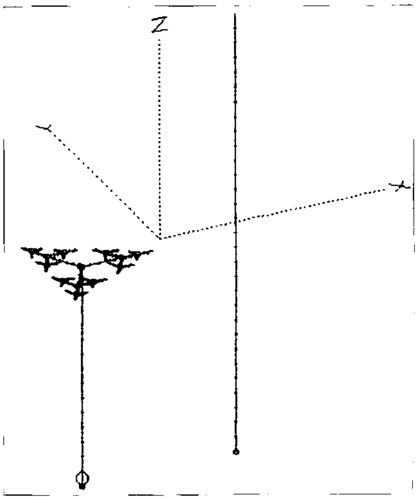

Fig. 2. *Schematic of an 1/8-wave vertical with a ternary fractal top hat, shown next to a 1/4-wave.*

Have We Been Had?

Again?

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I am sure that many of you have heard about what was called the "Big October Meeting." For those of you who have not, it was a meeting called by the ARRL for those of us in the frequency coordination community to discuss our problems and talk about setting up a national organization. I am Bill Wells WA8HSU, Chairman of the Indiana Repeater Council, and I attended that meeting. Why should you care about this? Well, this will have an impact on repeater coordination and band planning all over the country, so if you operate on the VHF/UHF bands or ever plan to operate on the VHF/UHF bands, you'd better care! Before I continue, a definition of "Ex Parte Communications" might be helpful to you. An Ex Parte Communication is any communication which is not part of the public record, concerning a pending or proposed legal action (a rule-making is a legal action) which may influence the outcome of the action. Example: I talk to the judge who is conducting your trial for drunk driving and tell him that I saw you drinking with my wife and you were stoned. This is an Ex Parte Communication because I am not a witness; that is, I am not called to testify at the trial. Ex Parte Communications are not only immoral, they are also illegal. I ask you to consider the following material carefully and then ask yourselves if an Ex Parte Communication was involved.

The nation's frequency coordinators were called to this meeting in St. Charles, MO, by the ARRL. We were told that the first order of business was to respond to a request from the FCC that they (the FCC) be provided with a single point of contact to interface with the coordination community. In fact, we were sent a total of seven different agendas for this meeting if you count both those which arrived by Internet E-mail and those which arrived by good old USPS snail mail. All of these agendas contained the following item as agenda item number one:

1. Discussion and Decision: Response to FCC request that it be provided a single point of contact with the coordination community, through which the FCC would recognize and support local and regional coordinators. (This was cut from an E-mail message which was sent on September 11, 1995, to the Coordinators Internet Remailer by Steve Mendelsohn WA2DHF, former ARRL Hudson division director, now the ARRL first vice president).

> ***"Book publishing is something which the ARRL does very well and they make a lot of money doing it."***

Well, this seems pretty clear-cut. We were told that the FCC had requested that the League set this thing up for them so we all went (some of us not very happily) to St. Charles MO, on October 7, 1995.

The ARRL had all their heavyweights there: President Rod Stafford, Executive Vice President Dave Sumner, General Council Chris Imlay, and half a dozen or so division directors and members of the executive council. This heavyweight presence would certainly belie the ARRL claim that they were only there to serve as meeting facilitator. Ralph Haller, the FCC deputy wireless bureau chief, was there and gave a short address to the group following a pep talk by Rod Stafford. Following his address, Mr. Haller held a question and answer session. During the Q & A session, Steve Wilson WB9SHY, the vice chairman of the Indiana Repeater Council, put the following question to Mr. Haller: "... Did the FCC, YES or NO, request the single point of contact (discussion) for the Coordinators' Meeting?" Mr. Haller's answer was, "No, we did not request it." Several minutes later Steve Wilson, now holding up a copy of the meeting agenda said, "I am holding in my hand a copy of the meeting agenda which was published by the ARRL which states: 'Discussion and Decision: Response to FCC request that it be provided a single point of contact with the coordination community.' Did the FCC, YES or NO, request a single point of contact for the coordinators?" Mr. Haller's answer again was, "No, we did not request it." Following that answer Rod Stafford quickly assisted Mr. Haller down from the speaker's platform. There is a videotape of this available to anybody who doubts me on this point.

Several times during the meeting ARRL representatives stated that they (the ARRL) are not frequency coordinators and have no interest in becoming a frequency coordinator. If you have a very recent copy of the Amateur Radio Service Rules, please turn to 97.301 (e) (3). This rule now states: "No amateur station may transmit in the 219-220 MHz segment unless the licensee has given written notification of the station's specific geographic location for such transmission in order to be incorporated into a database that has been made available to the public. The notification must be given at least 30 days prior to

making such transmission. The notification must be given to: The American Radio Relay League, 225 Main Street, Newington CT 06111-1494."

It sure sounds to me like the ARRL is in fact a frequency coordinator and has usurped coordination of 219-220 MHz from the local and regional frequency coordinators, such as the Indiana Repeater Council, which are defined in the FCC rules at 97.3 (a) (21).

When the meeting came to a close it appeared as if the ARRL had been appointed by the coordination community as the single point of contact with the FCC. The Indiana Repeater Council, seeing a secret agenda at work here, went away very dissatisfied with the outcome of the meeting. A weekly amateur radio tabloid broadcast erroneously reported that Indiana would never support the SPOC even though we had provided a written statement to its editor of the conditions under which we would support a SPOC.

I want to state for the record that the Indiana Repeater Council is satisfied with the work of the drafting committee which was appointed at the meeting and will support the new national organization which has been proposed.

As I stated, we saw a secret agenda at work so we decided to investigate. The Indiana Repeater Council filed a Freedom of Information Act request with the FCC, asking for information concerning the supposed FCC request for a SPOC. One document which we were sent was most interesting. It is a letter from the ARRL Rocky Mountain division director and Chairman of the ARRL Ad Hoc Repeater Committee to Ralph Haller.

The letter is herein quoted in full.

"Dear Mr. Haller:

I want to thank you for the most enjoyable visit Rod Stafford, Chris Imlay, and I had with you earlier this week. You were most cordial and ***we appreciated your attention and input to our*** [emphasis added] ***repeater proposals***.

To summarize our meeting Monday, June 19, 1995:

1. The ARRL will hold a meeting in St. Louis, October 7, 1995.

2. We are inviting about 100 repeater coordinators to attend. The League will sponsor and chair the meeting as facilitator primarily for the benefit of the repeater coordinators. Secondarily, we hope the FCC (you) may benefit from organization and cooperation worked out by the coordinators themselves to help you solve repeater coordination problems arising from time to time. Thirdly, ARRL is acting in the belief the meeting may benefit the League members and all amateurs through better cooperation and coordination of amateur repeaters.

3. It is our sincere hope that you personally will be able to attend.

4. We view as goals: A. Appointment of repeater coordinators—including recognition of present, non-challenged coordinators. B. Setting of qualifications and criteria for appointment of coordinators. C. Licensing of repeater stations, with coordination a prerequisite to licensing. D. ***Single point of contact*** [emphasis added], through which amateurs will contact the FCC. E. An accepted method of dispute resolution, including methods of appeal and review. Consideration of whether the FCC should have a role in such resolution, and if desired, what such role should be.

5. The League neither proposes nor urges a role for itself beyond this single meeting. The League is acting solely as a facilitator, with the hope of seeing a national cooperative coordination resulting in widespread, effective use of repeater communication.

6. We look for you (the FCC) to agree with the goals set forth above and propose such regulatory action as may be necessary [emphasis added].

7. We look for an agreement among the coordinators that will provide the sort of self-regulating activity the Amateur Radio Service has traditionally enjoyed.

If you have any suggestions for the items covered in this letter, would you please send them to me, Chris or Rod.

Once again, thank you for your hospitality, kindness, and helpfulness to us and to the League."

There you have it. This letter shows that the SPOC was an ARRL idea, not an FCC idea. You add that to Mr. Haller's clear statement at the meeting that the FCC did not request the SPOC and you can see that this was an ARRL show all the way. Now, I am not a lawyer, but bearing in mind the definition of Ex Parte Communications which was presented at the beginning of this article, it would appear that if the ARRL Chairmen as well as Stafford and Imlay have not committed Ex-Parte Communications, they are at least well down that slippery slope and they have at least carried out a great deception on the coordination community as well as on the amateur community in general.

But why, you might ask, would the ARRL want to promote this deception? What do they get out of the deal?

One thing is greater stability in the coordination community. This, everybody agrees, would be a good thing. There is something else which they would get if they were appointed as the SPOC: control of all the coordination databases, which would guarantee that they could publish any repeater directory product they wanted and be forever free from any possibility of being charged a

royalty for use of the data. This would also place them in a position to prevent any other publisher from using those same databases. It would also place them in a position to eventually charge you a fee if you wanted to coordinate a repeater and to set a national band plan.

Now, I have no objection to the ARRL publishing a repeater directory. Book publishing is something which the ARRL does very well and they make a lot of money doing it. The *ARRL Repeater Directory* is in fact the ARRL's most profitable product. By publishing a repeater directory the ARRL is in fact doing me as a frequency coordinator a great service. However, we at the IRC, and most other frequency coordination councils, operate on a shoestring budget and the council officers often put up hundreds or even thousands of their own personal dollars to get the tools needed to provide the service which we provide to the amateur community.

A fair royalty charged to any publisher, including the ARRL, for the use of the coordination databases which we generate and maintain could fund the national organization which the ARRL seems to want as well as the underlying local and regional frequency coordination councils.

So I call on the drafting committee to keep the SPOC organization completely free of the ARRL and to negotiate for the coordination community a fair royalty for the product of our collective labor. I would say that a good starting point for this negotiation would be 10% of the sales revenue plus 20% of the advertising revenue generated by the product to be licensed to be divided between the national organization and its underlying local and regional frequency coordination councils. What the ARRL and all other publishers would get for their money is better frequency coordination, more accurate databases, and greater stability in the frequency coordination community. The ARRL and other publishers would therefore be able to produce a higher quality product for you, the amateur community. 73

NEVER SAY DIE
Continued from page 9

With all due respect to this year's banquet speaker, they should have spent whatever it took to get Jean Shepherd K2ORS/4 up there on the podium. I don't know of anyone else in ham radio who can entertain like Jean. Old-timers will remember him for years on WOR every night. They'll remember his stories in *Playboy*, his books, and his movies. Pry him out of Sanibel Island.

I may be doing Paul Shuch, this year's speaker, an injustice, but since I have a lot of trouble with his whole SETI idea, considering it a big waste of time and money for reasons I'll cover in my editorials, his talk didn't make me want to go to the banquet. Shep would get me to the banquet, if I were coming to the HamVention. And he might tip the scales, if all else was equal, to bring me to Dayton.

Hey, it's show biz, guys.

SETI

Ask me why I'm sour on the search for extraterrestrial intelligence (SETI). Okay, glad you asked.

It has to do with cosmology and the age of the universe. Have you read any of the books on the subject on my recommended book list? Even if you accept the big-bang theory, which is more of a religious matter than one of scientific fact, the universe checks out to be at least 15-20 billion years old. And our earth is only a measly four billion or so.

And our poor old solar system is way out there on a remote arm of our galaxy. Thus, if you accept that life somehow is able to get started on new planets where the right conditions prevail, and considering that there are hundreds of billions of stars, presumably all or most with planets, the likelihood is that there are billions of worlds where life has developed to a fairly advanced stage. The likelihood is also that a bunch of these got started even billions of years before we did. Or even more, if you are not a worshipper of the big-bang theory.

Now let's switch to radio communications, which is a big deal right now. One hundred years ago scientists were managing short-range contacts with spark and Morse code. In a hundred years we've gone from spark to digital TV via satellites and global communications. Now, do you honestly believe that we are not going to make anything significant in the way of further communications developments in the next hundred years?

If you'd been a scientist a hundred years ago, how accurately could you have predicted the communications systems we have today, with cellular phones, paging, faxes, the Internet, and so on? Am I off-base to suggest that today's scientists have just as little chance of predicting what communications will be like in 2096 as those of a hundred years ago? And once you're with me on that, let's go to what communications systems

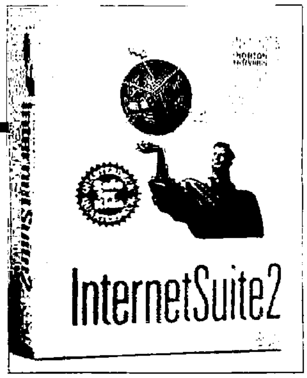
Continued on page 43

Number 40 on your Feedback card

73 Review

Communicating on the Internet

With Quarterdeck–license-free!



Don Johnson K7UGQ
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Enfield CT 06082

Once the little secret of college students and computer techies, the Internet has emerged as a popular method of communicating with hundreds of thousands of people. Unlike ham radio, where the media of transmission is RF energy, Internet communication takes place over the telephone lines. The Internet offers state-of-the-art, noise-free multimedia contacts with companies, hobbyists, and organizations, etc., without requiring a code test! In fact, it requires no license, test, or demonstration of computer or telephone knowledge. A true Plug-and-Play form of communication—or is it?

"This package has everything but the kitchen sink!"

Prior to 1993, communicating via the Internet required learning obscure UNIX commands, coupled with several different executive programs for each of the different tasks performed on the net. Mail programs, telenet programs, dialers, and browsers were commonplace. In fact, you would never have used the words "multimedia," "program integration" and "Internet" in the same sentence. Talk about an oxymoron!

Like the rest of computer technology, Internet software continues to evolve rapidly. Although the improvements are transforming the way individuals communicate, the rapid pace of change is often frustrating, as is the possibility of choosing the wrong software for your needs. When software is quickly developed and brought to market, it's often difficult to use. Initially this was true with Internet software.

Several programs are necessary to complete the complement of software for full-up Internet communication. Individual ancillary Internet programs can be obtained from any number of software dealers or downloaded, often as developmental software. Some companies offer many of these programs, integrated as a suite of Internet applications. Bundled software often offers similarity of operations between applications, and/or commonality of file service. This translates to ease of set-up and operation. If you think setting the clock on your VCR is clumsy, try installing Internet software. A whole new world of terminology and technology is standard equipment when dabbling on the net. For example, the following statement was extracted from a browser's set-up sheet: " ... make sure that you obtain a service provider that offers a local telephone number PPP capable of TCP/IP connection with full HTTP capability." Throw in set-up questions like: "List your domain address, your popd and smtp address and your IP address," and now you're ready to pull the plug.

One supplier of integrated Internet software has gone an extra mile to assure success for first-time Internet computer users. The Internet Suite II program by Quarterdeck Software™ not only offers a full multimedia browser, but all the optional Internet tools required to establish an Internet account, or use an existing account, with very little effort. In fact, the box should have a label reading something like " ... prior Internet knowledge not required ..."

Quarterdeck's Internet Suite II© is an integrated set of essential (and then some) communication programs for both on-line and off-line communications. Designed for Windows 3.X and Windows 95, this package supports both Internet and INTRANET (Internal Local Area Network) communications, and is loaded with goodies. Real Audio Players, QuickTime movie viewers, Adobe Acrobat viewers, full functional Internet Directory, and Norton Utilities anti-virus software are included with the package. A very nice addition is the Cyber-Sitter, providing parental control over sexually explicit matter. Not only is this an easy program to install and operate, but it's a safe one too!

Component highlights

Qmosaic Browser: The most common piece of Internet software and surely the most talked about is the browser (see sidebar). The Qmosaic Browser supports HTML 2 conventions with data security and full encryption, and provides very fast multiple document reads. Powerful drop-and-drag support eases organizing Internet addresses.

Qmessage Center: More than just an E-mail program, the true power of integration shows up here. Full-featured Electronic mail, Usenet and Newsgroups are among some of the message center features.

QTerm (TELNET): Emulates DEC VT52, VT100, VT220 data terminals.

QFTP: Point and click interface that works with Windows File Manager to allow downloading of software from other people's computers to your own.

Global Chat: Participate in live chat sessions using Internet Relay Chat (IRC). Chat rooms are similar to having a packet QSO.

QWinsock: Contains a multi-feature dialer that can coexist with other winsock programs installed. Automatically detects and identifies your modem and executes dial-up procedures whenever an Internet application is run.

Location Manager: Provides phone numbers the user can dial to access the Internet and handles all the details. Includes the initial "Connect and Play" feature, a list of over 80 percent of the leading Internet providers, including the phone numbers and set-up strings. Additionally, over 250 popular modem phone numbers and set-up strings are included.

Each module can be modified to satisfy your individual preferences. If it weren't for the default settings, the amount of user configuration could become a real headache. For the beginner, too much versatility may be a disadvantage. However, as you progress from the Newbie stage to becoming a more proficient user, you'll appreciate the power of a fully configurable program.

The users' guide consists of over 400 pages of tips, screen drawings and instructions to assist you toward success. The guide is also organized in a logical sequence, set up the way most people would discover each module in the suite. If you can't find something in the documentation, try asking Quarterdeck via any one of the avenues given.

While including so much, Quarterdeck did leave out a few, albeit minor, features. Internet Suite cannot handle newsgroup threads, level 3 HTML, or Java support (if you aren't sure what these features are, don't worry. They handle advanced initial on-line connection to the Internet and tie together news groupings by subject). Missing from the excellent user guide is assistance for the Cyber Sitter, Anti-virus, and real audio/video components of the package. There is, however, more than adequate on-line information to assist you with these advanced programs.

As I said, this package has everything but the kitchen sink! There are other Internet programs that offer a little better capability individually, but nothing as well integrated, as much fun, or as easy to get started as Internet Suite II. After you get logged on to the Internet, send me an E-Mail. I'll send you a reply E-Mail confirming the QSO, a sort of QSL card from the state of Connecticut. Care to try for Internet WAS? Besides being another form of communication, it's a lot of fun!

Contact: Quarterdeck Corporation, 13160 Mindanao Way, Marina del Rey, CA 90292-9705; phone: (310) 309-3700, FAX: (310) 309-3217; E-mail: support@quarterdeck.com.

Web Browsers

Web browsers provide a computer window into the Internet world of graphics and information. Before today's plethora of web browsers, Internet searches were text-based, offering no real multimedia excitement for the viewer. Credit for the first real web browser goes to the National Center for Super Computing Applications. As the creators of a program called MOSAIC, they almost single-handedly opened up the World Wide Web to public viewing and scrutiny. This one development is credited with sparking the phenomenal rush to get on the Internet.

Several commercial companies saw opportunity in improving the original MOSAIC program. Each company added their own bells and whistles; however, most browsers in use today are related to the original MOSAIC program.

An Antenna Plotting Oscillator

Here's a handy one-chip piece of equipment you can build.

Richard Q. Marris G2BZQ
35 Kingswood House
Farnham Road
Slough SL2 1DA, England

My interest in experimenting with small loop antennas, mainly for 80 and 160 meters, got me interested in building a small signal source to use for checking their radiation patterns. For years I used an old surplus BC-221 frequency meter as a source, but when I read about the Harris HA7210 low power crystal oscillator, available in an eight-pin IC, I knew it was time to upgrade my test equipment.

A big old BC-221 is okay for checking small rotatable antennas, but I wanted to be able to check the radiation patterns of larger low-band antennas, and that meant being able to move the signal source around, instead of the antenna. The HA7210 is a crystal-controlled Pierce oscillator which can be programmed to operate between 10 kHz and 10 MHz. All it requires is the addition of a parallel mode crystal and a 0.1 µF bypass capacitor, plus a DC supply of up to 10 volts. The power consumption is well under 1 mA, so even a 9V transistor radio battery will do the job just fine. The circuit is shown in **Fig. 1**.

Changing the links between pins 6, 7, and 8 selects the desired subrange between 10 kHz and 10 MHz, as detailed in the Harris HA7210 specification sheets. I used three crystals, which are selected by SW2. The frequencies of these parallel mode crystals can be anywhere in the bands you want to check, from 160m up through 40m. This means that any convenient junk box or low cost surplus parallel mode crystals can be used—for example, the prototype used 1 MHz, 1.850 MHz and, 3.5860 MHz. These were all HC49U type crystals.

This is a small gadget, so find something small in which to build it. Any of the common mini-boxes are suitable. The supply voltage I used was +6 volts DC, supplied by four AAA batteries in a battery holder. The consumption was between 450 and 800 µA, depending on

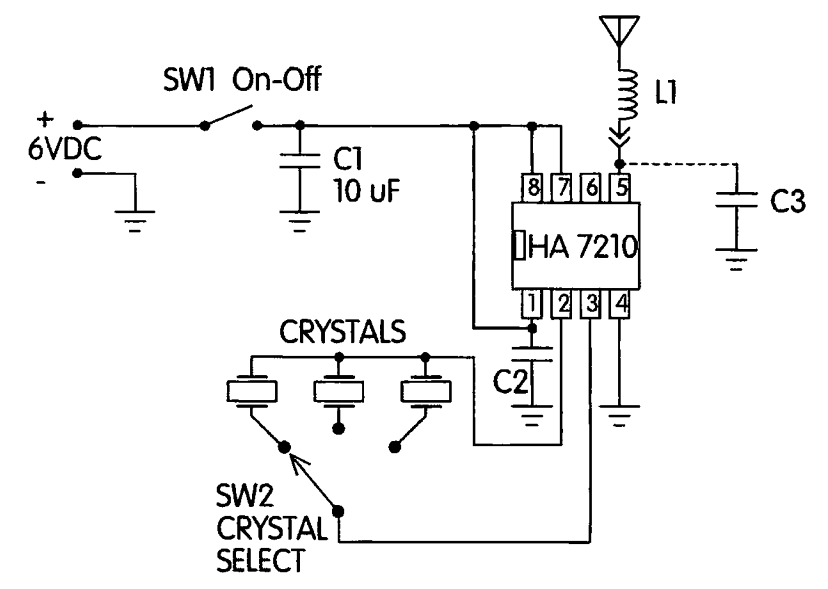

Fig. 1. The circuit.

Parts List

IC	HA7210P - Harris semiconductor
Socket	Eight-pin socket for HA7210P
SW1	Mini-toggle on/off switch
SW2	One-pole/three-way small rotary switch
Crystals	160m, 80m, and 40m (HC49U okay)
C1	10 µF capacitor
C2	0.1 µF ceramic capacitor
C3	4.7 to 30 pF, if required
L1	1 mH small RF choke
Plug	Phono plug with plastic case
Jack	Phono jack
Box	Your choice
Whip, battery holder, etc.	

the frequency and the output loading. Make sure that the leads to C2 (0.1 µF) are as short as possible, and use a plain perforated board to avoid any possible ground plane effect you might get with a copper-clad board. Otherwise the layout is not critical. In the unlikely event of instability, add C3, trying from 4.7 to 30 pF with short leads. The oscillator will only radiate for a few feet so it won't cause QRM or TVI. If you need a stronger signal, use a longer whip. In my work with loop antennas I rotated them and plotted the signal strength. With fixed antennas you move the oscillator around the antenna in a circle while taking field strength measurements for your plotting points.

This new IC is well-documented by the manufacturer. Ask Harris Semiconductor, Box 883, Melbourne, FL 32902, for copies of their "BA7210 Low Power Crystal Oscillator," File No 3389.3, and their Application Note AN9317, "Micropower Clock Oscillator and Op Amps provide system control for battery operated circuits." 73

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will be like in a thousand years. Ten thousand? A hundred thousand? A million?

Our first civilizations didn't get started until about 5,000 years ago, and I'll have more to say about that when I get Sirius.

Is it even remotely possible that some new communications medium will be developed that we don't even suspect today? Or perhaps, like telepathy, that we do suspect? One that doesn't have the bandwidth, interference, power, and time constraints of radio?

It seems to me that radio communications is just a passing technology that will eventually be replaced by something substantially better. It's a phase that many civilizations will go through for maybe a hundred years or so of their existence. Thus, trying to find worlds which are advanced enough to use radio, but have not yet moved on to better communications systems, a matter of perhaps a couple hundred years at best, out of millions, seems like a huge waste of money. We might do better to invest our efforts in researching other communications systems.

If, for some reason, you have some doubts about there being alien civilizations which have visited earth, then you are in serious need of some reading. Erich von Däniken in his *Chariots of the Gods* makes a good case for prehistoric alien visitors. As does Graham Hancock in his *Fingerprints of the Gods*. Now I'm reading *The Sirius Mystery* by Robert Temple. Maybe you've seen the TV exposé program on the Dogon tribe in

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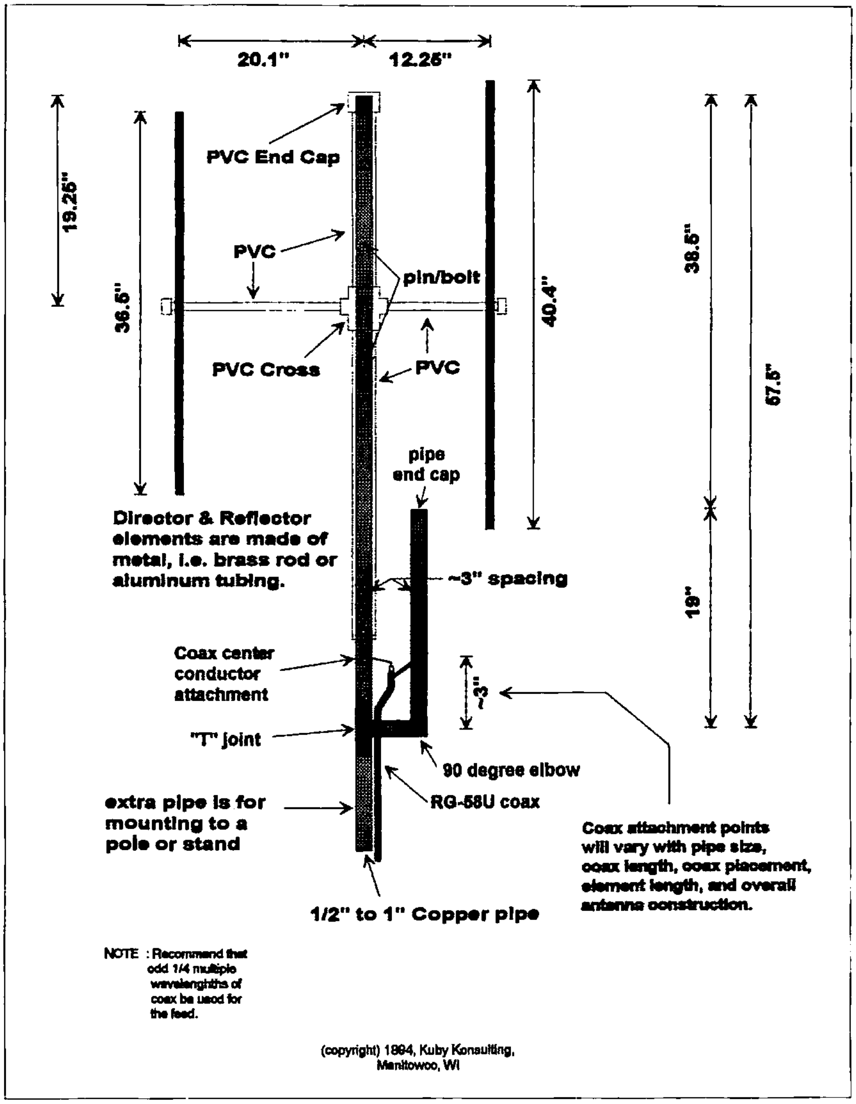
Number 45 on your Feedback card

Updates

A Big Blushing OOPS!

You may have wondered, while reading N6JSX/9's article "The 'J' Antenna" in the August issue, what you were supposed to be looking at. Well, the gremlins and goblins that frequently throw parties at our production outsourcer's place seem to have slipped the illustration of the J-Pole, that was the whole focus of the piece, back into the folder without its being placed. We are abject.



More Power?

An "oops" note from William Jacobs WA8YCG about his article "Economic High Current Power Supply" which appeared in the June 1996 issue. Please note that in the parts lists and on the schematic, both appearing on page 52, R3 should be **3.3k**, and R4 is **750Ω**. Bill also wants to thank all the readers who have written with encouragement and good wishes.

Ham Shack Unplugged

If you happened to be floating around in cyberspace recently, perhaps you came across those three runaway words that escaped from our mainframe just before we sent the July issue off for printing.

Refer to Frank Brumbaugh's "Ham Shack Test Equipment" which starts on page 10 of issue #430. On page 83, in the second column, about two thirds of the way down, there is a space just big enough for the words "plug-in units." Coincidentally, those are the exact words that should be in that empty space.

A Picture's Worth a Thousand Credits

The photo of the CMOS Super Keyer 3 on page 80 of the July '96 issue should be credited to Marshall Emm.

Number 46 on your Feedback card

Saving Ourselves From Ourselves

It's called getting involved.

Charles M. Seay, Sr. KN4HL
106 South Main Street
Dickson TN 37055

My license and yours were issued under Federal Commission Rule 97.1 in recognition and enhancement of the value of the amateur radio service to the public as a voluntary noncommercial communication service, particularly with respect to providing emergency communications.

Sometimes we forget that after receiving our licenses. We have a tendency to get caught up in our own little part of the amateur spectrum, not bothering to try new things. However, these licenses are a grant from the government and we need to channel more of our individual and club activity into public service.

Interface with your community

One of the reasons that amateur radio has not been growing as fast as it could is that licensees have not made themselves and their clubs as visible to the public as they should. Only occasionally do you see an amateur call plate on an automobile. Most states will provide an amateur operator with a callsign plate (upon proper application) for no more than a regular license plate costs.

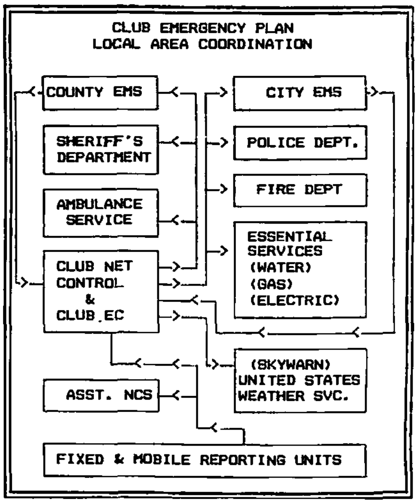


Fig. 1. Local amateur radio club organizational and information flow chart. Your own club's emergency plan should be reproduced and given to each department head in your community (this chart is from "Organizing a Club Emergency Plan," published in Radio Fun, *June 1993).*

Amateur radio clubs start and then fade because club activities are rare or nonexistent. Members need activities to keep them motivated. Club members should make every effort to build working relationships with the local Sheriff's Department, Police Department, county and city emergency medical service, ambulance service, water, gas and electric departments and especially the local Emergency Management Agency.

"When one department has developed a relationship with your club, others will follow."

It will take hard work on the part of club members to win the confidence of the department heads. These people instinctively start protecting their individual turf when outsiders offer help. Be patient; if approached in the right way these folks will become appreciative of your efforts. Sheriffs' and Police Departments may be the most resistant to your efforts, but don't give up. Police Chiefs must be reassured that club members are not trying to be police officers. Approach the Chief with the idea of club members being a mobile neighborhood "watch on wheels." Invite the Chief or Sheriff to a club meeting two months before Halloween and offer to help Halloween night to crack down on vandalism, reckless driving, or other activities that the Chief or Sheriff may suggest. If he accepts your offer, plan your activities in conjunction with his office and follow his instructions explicitly.

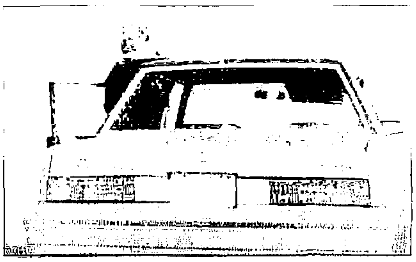


Photo A. Joyce Seay KC4RNX (now AD4EX), on patrol with "Operation Goblin" in association with the local Police Department. At Halloween each year, most Police Departments welcome extra eyes and ears to prevent vandalism.

When one department has developed a relationship with your club, other departments will follow.

Be ready

Let the emergency management agency in your area know that club members are able, willing, and ready to answer a call for help in an emergency. This might include storm damage surveys or providing communications at emergency shelters.

Each club should develop an emergency communications plan, including an information flow chart like the one shown in **Fig 1**. Make copies of this chart and add a brief description of the club capabilities in the event of an emergency. Deliver these charts to each of the department heads and invite them to a club meeting. Even if they don't use club members in their operations, the question and answer session will make a superb program for that meeting.

Inactivity in amateur radio clubs is a disease that is completely curable if club members will just get off their duffs. More people rust out than wear out—let's scrape off the rust and get involved! We owe that much to our communities. 73

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Mali. Their religious rites are based on a visit from aliens about 5,000 years ago. The aliens were from a planet circling Sirius B. This is a star that was first spotted in 1970. It's a white dwarf that circles Sirius A, which is a very bright star. Well, you really ought to spend the $17 for the book and be amazed at how closely the Dogon tribe's stories tie in with facts discovered only recently.

There's a strong suggestion that these visitors may have helped mankind start our first civilizations, which somehow sprang up almost overnight in several places ... like Egypt and Sumer. The more you read about the pyramids, the more believable is this story. How about temples built so Sirius A shines down a long corridor on New Year's Day to spotlight the altar? The Temple of Isis at Denderah is a good example. Coincidence, right?

Are the thousands of stories of current alien visits all hokum? And if so, why is our beloved government going to such extremes to shut up people who report having seen them?

Well, whether aliens are here with us now or not, it seems like a big waste of money and time for us to be listening for alien radio signals. Maybe we'll hear a spark rig from some new apes on the block.

W4JJ

A reader pointed out that Jerry Freeman's call was W4JJ, not K9AAH (in a May letter). Yes, I should have caught that! But I hadn't heard that Jerry, shortly after retirement, died of a brain tumor. I've had several friends die of brain tumors, so I've been particularly interested in reading books which go into how to avoid them, and how to get rid of them without the usual medical procedures. I sure wish Jerry had let me know that he had a problem. He was only 63, so he could have had at least another 40 healthy years or so ahead of him if he'd taken enough interest in his problem to discover some of the powerful alternatives to the medical industry's usual approaches. You just don't get cancer if your immune system is strong.

More Celebs

A note from my old friend Tim Chen BV2A, whom I used to visit every year when I was leading tour groups to the Asian electronics shows, reminds us that AC3PT, the King of Sikkim, should be added to the celebrity list. And Tim also points out that our DX Dynasty Award should now recognize Pratas Island BV9P. The rule is simple for the DXDA award: Any country accepted as such by a national ham organization of any country is recognized for DXDA credit. This makes it possible for someone with little else to do to work 400 countries.

In all fairness, I had a lot of fun working 350 countries. It took me a couple of years. But I find I'm a "been there, done that" person, so I don't have a lot of enthusiasm for repeating things I've already done. Like one time for visiting most countries is fine. Maybe that's why, when I start a new magazine, I'm ready to sell it once I have it going well. A sort of seven-year itch thing, maybe.

Ted Chernin KH6GI faxed me a reminder that Wells Chapin W8GI had an article in the May 1969 *73* on ham celebrities. Ted must have a lot better index of the back issues than I.

NASA Update

My review of René's *NASA Mooned America* (in the June issue), wherein he made a case for the whole Apollo moon program being a hoax, á là the movie *Capricorn One*, infuriated some readers and got a bunch more to read the book to see for themselves. This has kept René busy having more books printed for us, while keeping an eye out for CIA spooks.

A reader I've known and trusted for many years wrote to tell me about an experience he had while working at the NASA Goddard Space Flight Center in the mid-'70s, maintaining the computers and telemetry equipment. He was surprised at how antiquated the computers were, being mainly Univac M642Bs, an early generation which had been resurrected from Navy ship fire control systems. Data storage was on paper or mag tape.

One day he needed a mag tape for some work and none were available, so he poked around and found an old unmarked tape in a storeroom that looked okay to use. But when he checked to see what was on it he found it to be the info used to drive the displays in the Operations Control Center during an Apollo mission. It was a tape which was normally run during a mission to log all activity to tape for later analysis. So what's the big deal? The tape's creation date was well *before* the mission took place! However, considering how the system was set up, he knew it was impossible for a mistake to have been made in the creation date.

In addition, he noticed that the tape was too clean to be a legitimate log tape. Normally, the log tapes have a lot of data on them from the unexpected things that happen during "real world" operations. That's the purpose of the log tapes. Nor was it a simulation tape; those were only a few minutes long and not an entire mission tape such as he'd found.

Having done an in-depth report on that Apollo mission in school, he knew the dates were wrong. This has been worrying him ever since, but he prudently kept quiet about it.

Other than a few letters from angry readers who are convinced that our beloved government wouldn't lie to us, and who have no intention of reading the book, I haven't seen much to refute the 30 points René makes. I want René to be wrong, but he makes a very solid case. The book is $25 (plus $5 s/h) from Radio Bookshop.

Many of the readers who got his *Moon* book have since ordered his *Last Skeptic of*

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Never Say Die

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Science book (also $28, including shipping). A couple readers have raised questions, but René has done his homework thoroughly, so nobody has stumped him on anything yet. No ice ages? Ridiculous! But René's explanation fits the facts and the whole idea of ice ages doesn't.

Pirate Caught!

During the recent Sea-Pac convention in Oregon the Phantom Amateur Radio Group (PARG, from Beaverton) was enjoying their annual bonfire on the beach when one of the members, who was monitoring the police channel, heard someone break in cursing. They quickly turned on their direction-finding equipment and within five minutes had located the pirate at a nearby motel. They could see him on the third floor balcony talking into his HT. Another member stopped a nearby police cruiser and explained that three club members were on their way to the pirate's motel. Just before they arrived they saw the pirate come down the stairs and run off. A couple hours later the interference started again so the police went to the room the members had pointed out and caught the chap in the act. The pirate is reported to be KE6VNU, who was there for the convention. It turned out that he'd been released from jail just shortly before this incident. Yep, for causing malicious interference in his home area.

Now, will the FCC lift this guy's ham ticket?

Calling Channel

A letter from Ralph Gaines WL7DU makes a good point. During an ARRL contest he was trying to maintain contact with a vessel in distress, only to have the boat's weak signal clobbered by contesters. My suggestion is for contest sponsors to set aside parts of each band as out-of-bounds for contesting. Further, maybe it's about time to establish a "calling frequency" on each band where emergency traffic would have priority, but which could be used for establishing contacts the rest of the time. It would be a good channel to monitor, with callers checking in, as we do with repeaters. And once a contact is made, the QSO would move to another channel to continue.

On 20m we might set aside 14.275-14.300 for non-contest contacts, with 14.285 as the calling/priority frequency. 14.275 would be better, except that it's used for blind broadcasting many hours of the day by K1MAN. Or do you have a better suggestion?

Talk Radio Lives!

Art Bell W6OBB called and asked if I would be a guest on his radio talk show again. Sure. I knew I'd get another big pile of mail like last time, but the upside was that I would have an opportunity to talk about ham radio on a program with tens of thousands of listeners.

The interview was on Friday night. On Monday morning a stack of letters 18" high arrived. And it kept up like that for almost two weeks before slowing down. Two months later I was still getting a dozen or so letters a day!

Art and I talked for four hours. His show is rated #1 in Los Angeles, Seattle, and many other markets, so it has a humongous audience. My first interview six months before brought over 2,500 letters. Friends in the Denver area said that I was on for six hours—the four hours I talked live, plus a repeat of the first two hours. And the program was repeated by many stations over the next couple of days.

Many of the letters from regular Art Bell listeners said this was his most interesting show ever. With the Dayton HamVention no longer asking me to talk, I needed confirmation that I'm still interesting. Well, I can understand the pressure the HamVention must be under from the ARRL, which views me not as a fellow ham or entertainer, but as a business competitor. And money rules, both in Newington and in Dayton.

Art and I talked a lot about how much fun we've had with ham radio. But I also couldn't help mentioning my 28-page list of 83 books you're crazy if you don't read, the Bioelectrifier, cold fusion, the René book about NASA, and so on. You know, all that stuff you grumble about me writing about in my editorials. I didn't even have time to get into dowsing, UFOs, contactees, reincarnation, and weirdo stuff like that.

Picture 300-500 letters a day to be opened, read, envelopes addressed, a 12-page list of my available booklets stuffed, and a quick answer to questions added. Well, if it'll help get us a few more hams, it's worth it. And I think it will help because subscriptions to *73* are pouring in. Yes, I did most of the work myself. In case you wondered, AM radio is alive and well. I wish I had time to do more interviews like that. I also wish I had the time to personally answer more of the letters. But if I can get people to start reading some of the books on my list they'll at least have the information it takes to live longer, much healthier lives. However, I've found that health is way down on the list of important stuff for most people, at least until something goes so wrong they have to go to the doctor—who looks them over and then leans back and says, "Uh, o-oh."

Art sure has a lot of listeners. The mail poured in from Hawaii, Alaska, St. Thomas, and all around the country. All 50 states!

One thing surprised me. Though I did get a few letters from hams, when I think of the thousands of people I know personally through my work in the ham field, computers, the music industry, and so on, none of the mail came from people that I knew. Well, 350 million is an awful lot of people. Now, how can we reach more of them with our message of how much fun and adventure we have available for them in amateur radio?

Missed You at Dayton

Not being asked to speak, plus deciding not to be tied to a booth, and not being able to get away for five days anyway, I skipped the HamVention again this year. That's maybe three skipped over the last 41 years. Well, it's turning more and more into a computer flea market, like most other hamfests. I haven't been a computer hobbyist since the TRS-80, one of the first integrated microcomputers, came out in 1977. I've been a user. I got a TRS-80 Model I the day it was introduced. And their Model 100 laptop the first day it was available, in 1983. But then Radio Shack did their $50 billion-plus screwup, dropping from 40% market share to around 1%, so eventually I replaced my trusty old 100 laptop with a Macintosh PowerBook.

How was Dayton for you this year? Were the talks exciting and well-attended? What did you buy? What did you see that was new and interesting? What did I miss?

1960, When *73* Started

With my 74th birthday on September 3rd, and this issue winding up 36 years of *73* (will I make it to 40 years?), I couldn't help remembering 1960, the year I started it.

That was an eventful year for me. It started off briskly when I was fired on January 5th as the editor of *CQ*. Well, things had started destructing along about Christmas. A little matter of some differences with the publisher. Like he owed me a year's pay. And I'd discovered he was a year behind on paying my authors for articles, and a year and a half behind on paying my columnists. Worse, my assistant editor dug into the circulation manager's desk one night and gave me a copy of the actual paid circulation of the magazine, which was less than half of the sworn statement circulation figures. In the publisher's desk he found a financial statement which showed that *CQ* had made $100,000 net profit in 1959, most of which had gone to pay for the publisher's new 58-foot yacht, which he had taken as a "business expense." Then, at Christmas, he gave me a $5 Christmas bonus, "wishing it could be more."

But he'd let me know in many ways that as the only outsider on the staff I really shouldn't count on a future. It was a family-run business and I had been hired at a desperate moment when the previous editor quit and *CQ* was losing a lot of money.

After being fired, I tried working for an ad agency. But my love was amateur radio, so I decided to take a gamble. I sold everything I owned of value and got together just enough money to print the first issue of *73*. Well, that's what entrepreneurs do.

At the same time I was working with the ARRL Hudson Division to put on a New York City ham convention. Chet K2EAF, a manufacturer's rep, and I sold all of the booths and helped with much of the organizing of the convention. Chet and I were disappointed at the convention banquet when Harry Daniels W2TUK took credit for everything, never mentioning our part. Honors apparently were very important to him, earned or not.

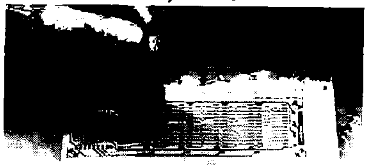
Also that year there was an article in *The Village Voice* newspaper about Mensa, a high-IQ club in England. They were looking for American members. I'd had my IQ checked in college so I knew I should qualify, so I sent for their test and became American member #15.

A few weeks later Peter Sturgeon, the brother of well-known writer Ted Sturgeon, called and asked if I was interested in forming an American Mensa group. Sure! So he, two other members and I met at his apartment in downtown Brooklyn and American Mensa was started. Since I had a mimeograph and an addressing machine, I became the first secretary. I got the list of people who had qualified from London and sent out meeting notices every month. The next two meetings were held at my house in Brooklyn, then we rotated to other members' homes. I decided to get the heck out of New York in June 1962, moving to New Hampshire, where I was the Mensa local secretary for many years. Peter later moved to Switzerland. The other two chaps who were there at the beginning disappeared. One was a schoolteacher and the other a reviewer for a book publisher.

If I'd stayed in New York I think Mensa would have turned out much differently. My goal was to get the members together in groups to brainstorm ideas to help solve our country's more serious social problems. I wanted to put those IQs to work, not just have a snob club. Mensa turned out to be totally useless and a sad waste of a potentially powerful resource. Well, that was my fault for moving to NH.

In addition to helping with the Hudson Division ARRL Convention and getting American Mensa started, I was also president of the Porsche Club and quite involved in organizing car rallies and club visits to the factory in Stuttgart to pick up new cars. I got the program started in 1958 and it was a great success. A hundred and fifty of us flew over on Lufthansa, picked up our new Porsches in front of the Solitude Castle, and then the

Continued on page 53



Number 50 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

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Houston, we have a problem—OSCAR 13's last Field Day.

Time is running out for AMSAT-OSCAR-13. While the satellite was online and working great for Field Day (June 22nd and 23rd) this year, next year it will only be a memory. Reentry should occur in mid-December. Many changes to A-O-13's orientation and operating schedule will begin soon, as ground-control stations stabilize the craft to prolong its useful life in the sky.

During Field Day 1996, most stations in the U.S. had only a few hours of access to the satellite in the early hours of Sunday morning, but it was worth it. The satellite was aimed at the center of the earth while at apogee (the highest point of its elliptical orbit), and conditions were optimum.

A-O-13 was originally scheduled for a major orientation change just before Field Day to keep the solar panels aimed at the sun. Because of atmospheric drag around perigee (the orbit's low point), the orientation had shifted on its own to a point that was acceptable for a few more days. The radical orientation change was not needed until after Field Day, so signals from the satellite were stronger than expected for the contest period.

"In early November things will begin heating up on board the satellite."

An explanation of the orbital mechanics and physics involved with the demise of A-O-13 requires a lot of math and interpretation. James Miller G3RUH has covered the topic in detail, and the information can be found via the Internet at the AMSAT ftp (file transfer protocol) site. The URL (Uniform Resource Locator) for A-O-13 information is *ftp://ftp.amsat.org/amsat/satinfo/ao13/*. Published articles by James can be found at *ftp://ftp.amsat.org/articles/g3ruh/*. For our purposes, it is sufficient to simply describe some of the events that A-O-13 will experience until its end in December.

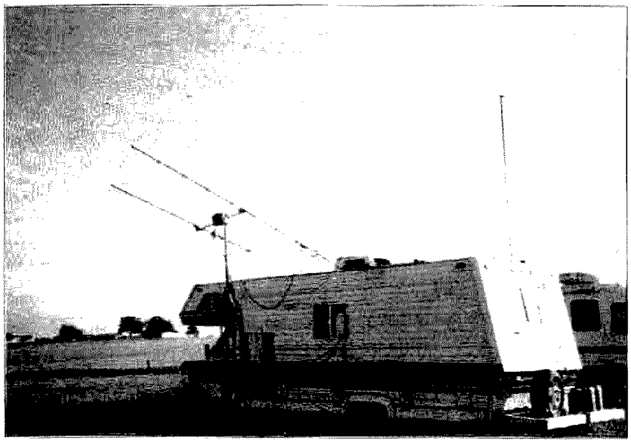

Photo A. The K5DX analog satellite station was set up in this RV at the W5SJS Ranch in South Texas for Field Day 1996.

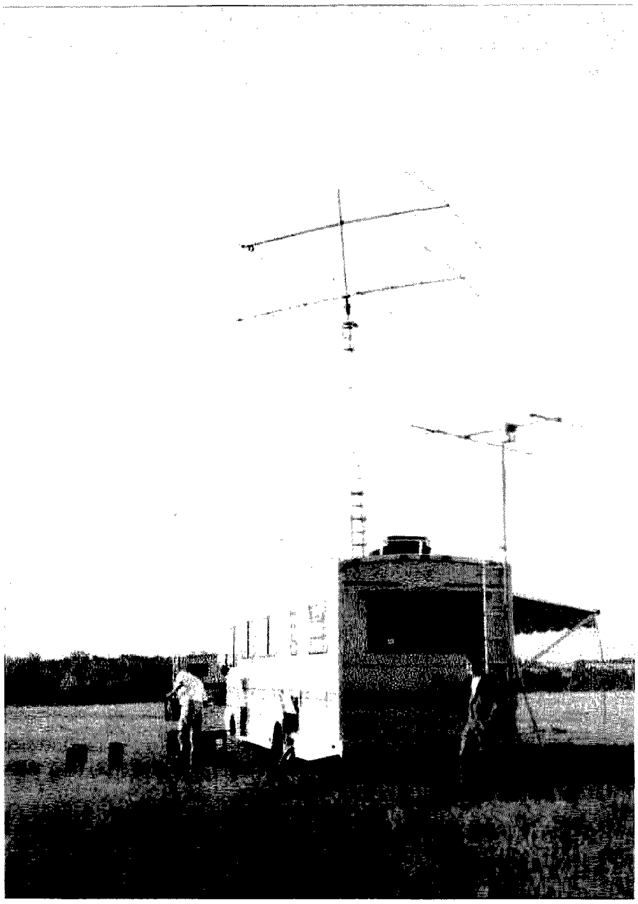

***Photo B.** N5DC and WA5ZIB outside the K5DX Field Day HF-SSB and digital satellite RV on the W5SJS Ranch.*

Subtle orbital changes began to occur in January of this year. The Mean Motion (number of orbits per day) started to decline due to atmospheric drag. By April, the satellite was losing about 80 ms per orbit. This may not sound like much, but old element sets begin to produce inaccurate computer predictions, and the problem gets worse each month. As with a low-orbit satellite, new element sets should be used whenever possible. The perigee was down to 300 km in May. By October it will be about 160 km.

From an operational point of view, normal A-O-13 orientation to aim the high-gain antennas at the center of the earth at apogee is ALON/ALAT = 180/0. Due to the atmospheric drag and heating problems that begin in the fall, the satellite orientation will be set to ALON/ALAT = 90/0 beginning in late August or September. This means that the satellite's high-gain antennas will be aimed away from users almost all the time. Heating problems will be minimized and orientation problems due to drag will be stable. The mostly-flat motor side of the satellite will be facing the atmosphere around perigee. The high-gain antennas and solar panels will not be "into the wind" with their unsymmetrical proportions.

The omnidirectional antennas and Mode-B transponder (70 cm up and 2 meters down) will be activated full-time when the orientation changes

are implemented. The omnis will be correctly aligned for good use both at apogee and perigee.

In early November things will begin heating up on board the satellite. At the end of May, the solar panel temperature was about 53° F. At the beginning of November the temperature could be as high as 100° F around perigee. The reorientation to ALON/ALAT = 90/0 will keep this down a bit, but by the end of November, temperatures could go as high as 480° F. Thermal cycling between the hot time around perigee and the colder periods during the rest of the orbit will likely cause the panels to crack. Solder may have melted by this time and the transponders may be fried.

helium balloons for late-night activity. The motor homes (with air conditioning and microwave ovens) and generators performed flawlessly, and contacts were fast and continuous at the voice, CW, Novice, and VHF/UHF positions.

Two satellite positions were added to the extensive array of stations this year: one for analog (voice/CW) satellites under the American Radio Relay League rules, and another for digital satellites and the AMSAT Field Day rules. All of the available satellites and modes were pursued, with only a few exceptions.

More on Field Day

AMSAT-OSCAR-10 has been in orbit since 1983. This

"The ARRL rules do not recognize digital activity through these satellites, but the AMSAT competition counted every Field Day message download and upload as three points."

As we approach the end of the useful life of A-O-13, many stations will be monitoring the telemetry. This will provide insight for future spacecraft designs, in addition to the educational potential. Don't forget to make some contacts via OSCAR-13 before the conclusion of the A-O-13 story.

The K5DX Field Day

The Houston AMSAT group went out with the Texas DX Society this year. The TDXS folks always have an incredible array of antennas, radios, and operating positions for HF work. Large yagis for 10 meters through 40 meters were raised on trailer-mounted towers. Guy wires were pressed into service as inverted V's for 75 and 80 meters, and a 75 meter delta loop was lifted by

13-year-old satellite is still performing very well. The computer memory is dead and the batteries are no longer functioning, but when the satellite is in sunlight the solar panels provide power and the Mode B transponder works well. Activity is usually very light, but for Field Day contacts were brisk and the downlink passband sounded like 20 meters. Signal strength was not as good as A-O-13, but after November, A-O-10 may be the only available high-orbit hamsat available for use.

The low-orbit RS satellites were packed. RS-10 with its Mode A transponder (2 meters up and 10 meters down) provided many quality contacts. Signals were strong and contacts were easy. RS-12 was active on both Mode K (15 meters up and 10 meters down) and Mode T (15 meters

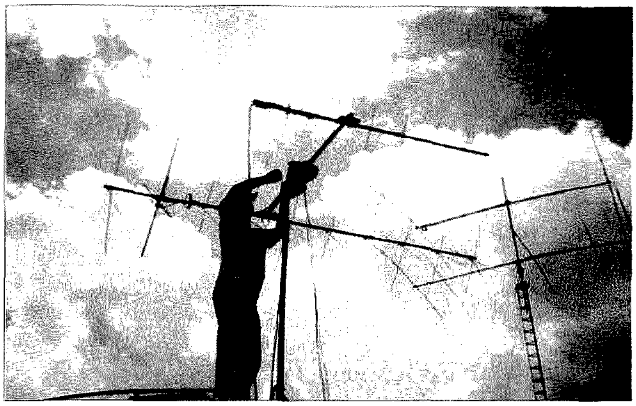

Photo C. *Mike WA5TWT finishes installation of the VHF/UHF array at one of the K5DX hamsat stations.*

up and 2 meters down). Mode T operation was easier for many participants. Interference from nearby 10 meter Field Day stations had no effect on the 2 meter satellite downlink. RS-15 was operational for Mode A activity. Although the downlink signals were weak, passes were long for a LEO (low-earth orbit) hamsat and many successful Field Day contacts were logged.

During the daylight hours of Field Day, AMSAT-OSCAR-27 provided FM QSOs for those equipped for Mode J (2 meters up and 70 cm down). The satellite is not activated for nighttime passes. Since this satellite provides only a single voice channel, it sounded more like a local FM repeater with everyone trying to talk at once.

Fuji-OSCAR-20 was available for voice and CW contacts. The Mode J analog transponder offered good QSOs, even though the Doppler shift was a persistent factor. A new Fuji is scheduled for launch in August. It will have an analog transponder in addition to 9600-baud packet.

While the 1200-baud digital satellites like AMSAT-OSCAR-16 were active for Field Day, the 9600-baud birds like Kitsat-OSCARs-23 and 25 had more traffic. UoSAT-OSCAR-22 also carried digital Field Day messages. The ARRL rules do not recognize digital activity through these satellites, but the AMSAT competition counted every Field Day message download and upload as three points.

Thousands of amateur-radio stations listened patiently

Photo D. *Andy WA5ZIB gets ready for a Kitsat-OSCAR-25 pass at the K5DX 1996 Field Day site in South Texas.*

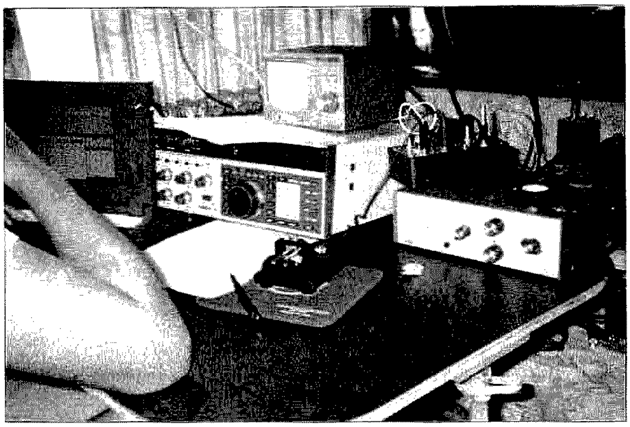

Photo E. The K5DX HF-CW station was simple, yet effective, with over 100 contacts per hour.

Photo F. An experiment worth trying: The K5DX HF team suspended an 80 meter delta loop with balloons from their South Texas Field Day site.

for the space shuttle. Mission STS-78 was up, but nothing was heard on the 145.55 MHz downlink. Shuttle experiments took precedence during the contest period. Hundreds of enthusiasts made voice and packet contacts during the days that followed Field Day, but not during the weekend.

"It was also a reminder to the long-time satellite enthusiasts of how much fun the hamsats are to work."

Field Day 1996 via satellite was an exciting event. Although it was the last for A-O-13, it provided many newcomers with an opportunity to experience satellite communications. It was also a reminder to the long-time satellite enthusiasts of how much fun the hamsats are to work. In the months ahead we can monitor the demise of A-O-13 and renew activity via A-O-10, F-O-20 and the many other satellites still in orbit and working great.

QRP

Number 52 on your Feedback card

Low Power Operation

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As QRP rigs become even more complex, using perfboard for their assembly has become the exception rather than the rule. Most of today's circuits require the use of a PC board. Also, you can just about forget the fingernail polish and resist pens. It's nearly impossible to lay out a PC board by hand using today's miniature parts.

By far, the easiest way to generate a PC board is to use one of several computer CAD programs. These programs are nothing more than fancy drawing software on steroids. I've used several in my time and currently use the DOS based CirCad.

Instead of focusing on how to make a PC board, I thought I would take a different approach. Laying out the PC board is almost as complex as the circuit you're building.

Get your ducks in a row

After you have a working schematic, and your project works, the next step is to get all the parts mounted on a circuit board. I find it best to start off with a sheet of paper and a pencil or two. Oh, and a *big* eraser! This first step lays the groundwork for the computer. It also forces you to show, on paper, the input and output jacks required. If you need an antenna jack, power or speaker output, now is the time to put those down on paper. Also, if you plan to use a part with a unique footprint you need to show that location on your work sheet. Let's say you're planning to use a BNC right-angle connector. Place this part on your work sheet in the general location you desire. You might also want to make a mental note that you can't locate parts under the BNC connector.

Move the parts around, trying to get everything connected with the shortest possible routes. But don't worry about all the connections; we'll let the computer work on those. Sometimes you can actually lay out the board to closely follow the schematic. The trial on paper give you a idea of how the PC board will look when it's finished.

Net lists

Most of the high-end PC board drafting programs include a sub program to generate net lists. To do this, you must first draw out your schematic within the CAD software. Sometimes the schematic drawing program is separate from the CAD software; in other cases it is built-in.

When you are sure the schematic is correct, you generate a net list, which contains all the connections you have drawn on the schematic. The net list knows that R4 pin 1 is connected to pin 2 of C11, and that pin 1 of C11 goes to the base of Q4. The net list then becomes the "rule" for checking what you have on the schematic and what you will do on the PC board.

With net list in hand, you can start to lay out the board. With CirCad, you input the net list for your project. The net list also contains all the required outlines for the various parts.

Since the net list imported all the outlines for the parts, you're ready to begin. Most people will put tack marks to mark the corners of the board. You can also draw an outline the same size as the finished board. I do neither—I just jump in and start moving parts around.

It's best to use standard spaces. I use .1 mil grid for all parts, then drop to .025 mil if need be. Always use the "snap to grid" option. It may be called other names by different programs, but it does the same thing. With "snap to

grid" on, you can drop a component on the board and the software will automatically place it on the closest grid point.

If your layout requires odd-sized parts or special connectors, use your paper work sheet and place those parts on the board. That done, you have several options, depending on the power of your PC board software.

If your software generates net lists, then it will do what is known as "rats nest" wiring. Here the software will connect all the different points as required by the net list. Since the lines shown are not actual copper traces, they cross each other back and forth, hence the name "rat's nest" wiring.

The purpose of the rat's nest is to allow you to move the parts about, all the while connected to the rat wires. You move and rotate parts so you have the shortest and best routes for each signal.

Routing and traces

Once you're happy with the layout, it's time to route the board.

I've gotten lazy with CirCad: I use the autorouter all the time. You can route the board by hand; however, if your software comes with an autorouter, by all means use it. Autorouters are not perfect, but they can help you design your board.

The autorouter may route your board correctly according to the net list, but the end result may not be the best design. Most autorouters that I have used are not smart enough to know the difference between a VCC line and a signal line. Also, if your project has an RF section, then the autorouter won't route the traces to ensure stability in this section. A good example is the emitter lead of a transistor used in the PA stage of a QRP transmitter. The autorouter may have in fact routed the emitter lead to ground, but the trace may be to one of several grounds on the board.

To ensure a stable PA stage, the emitter must be grounded using as large a trace as possible. This trace must also be as short as possible. The same problem occurs with VCC lines and heavy current. Large short traces are necessary to ensure proper operation. The collector of that power amplifier must have its trace wide enough to handle the intended current required by the transistor. But at the same time, the trace must be short and as direct as possible to avoid adding unnecessary inductance.

You can sometimes ease routing time by using copper pouring. The CAD program allows you to "pour" copper into large areas of the board. Copper pouring is great for creating a ground plane in selected locations.

As far as trace width goes, I autoroute with 10 mil traces. These give the autorouter the easiest way to make connections. After the autorouter is done, I edit the lines, making them wider than the 10 mil traces. I like to use 20 mil width trace between signal pads, and up to 250 mil width for VCC traces. I like wide traces on my PC boards. Perhaps it's a throwback to the days of resist pens and nail polish—in the old days, a thin trace was quickly etched away with the rest of the copper!

WB8VGE's tips

I know I don't know everything about laying out a PC board, but here are some tips I've picked up along the way. Perhaps you can use a few of these next time you lay out your PC board.

We place screw holes in the board so we can mount the board. Don't forget about the heads (or nuts) that will be inside those holes. If you place traces too close to the mounting holes, the screw head may in fact short the traces to ground.

There is the same amount of copper on the top as on the bottom. Unless you have a really simple project, think double-sided PC boards, even if you can't afford a double-sided board with plated-through holes. Lay out the board so connections on both sides of the board can be made by soldering a resistor lead on both sides. This will allow you to use sockets under the ICs, while using a board without plated-through holes.

If you do use plated- through holes, remember to take into account the .003 inches worth of plating inside the holes. If your mounting screws just barely make it though the holes now, after the plating, they may not fit! I use .038 inch holes, which after plating leaves me with .035 holes. This is my standard for resistor leads. You can use smaller holes, but the .038 size leaves me plenty of wiggle room in case I need to remove the part. The vacuum desoldering tool works much better with the larger hole size.

Watch out for capacitors. It's not so much the lead spacing, but the actual physical size of the caps that can throw you a tomato worm. A .47 mF capacitor has the same .2 mil lead spacing but may be nearly four times as fat, so the guy won't fit in between the rest of the parts.

"Here are some tips I've picked up along the way."

Keep an eye out for any kind of connector. It's easy to crowd the connector by getting parts too close to it. Really ruins your day when the first prototypes come in and, after you have the board stuff, you find out you can't get the connector's plug on!

Paper is cheap! I use paper from my recycling box that has been used on one side. Turn the paper over and run it through the laser printer one more time. Print all the time and as often as you can. The board looks a lot different on paper than it does on the screen. Check for traces that look just a tad too close. These may cause you trouble down the road.

Some software has the correct drivers to output to a color ink jet printer. That really makes it easy to check both sides on a double-sided board with one printout.

Don't worry about getting the board as small as you can. I know some of the QRP rigs have a built-in "cute" factor, but for first-time PC board makers, don't try for sub-miniature designs.

I'm out of room for this month. We'll take a break and pick up this thread in November. Next month, October, will be rather special. The October issue will mark ten years of this QRP column. Please join me at a look back at 10 years of "QRP."

NEVER SAY DIE

Continued from page 49

famous Porsche racing team taught us how to race them on the Solitude race track. Wow! From there we drove to Locarno, where over 700 Porsche owners from all over Europe gathered for a huge party.

Yes, 1960 was an eventful year. I wonder how many of you still have that original October 1960 37¢ issue? The cover cartoon was drawn by Bandel Linn K8LAP, who had a daily talk program on WSPB in Sarasota, Florida, where I had been an engineer-announcer back in 1950.

Nostrums

Being fairly vigorous and having an obvious interest in staying that way, I've been delving into the "how to get or stay healthy" literature. What a mess! There are dozens (maybe hundreds) of books claiming to have found the secret of health. Lordy! And if that isn't enough, every mail brings a booklet or colorful brochure advertising still more ways I can achieve robust health. And each camp, like our welter of commercial religions, has a group of dedicated true believers.

I've been helped a whole lot by readers who have recommended books or health approaches they've found beneficial. At any rate, in my role as a reporter and pseudo-teacher, and with my doctor and professor caps in the drawer out of sight, I've been doing my best to sort out what looks scientifically reasonable and repeatable in the health and longevity field.

Yes, I know, you probably don't care how long you live. Or even how long or healthily your children live. You know you and they are slowly committing suicide, heading towards heart attacks, cancer or a nursing home, or both, but then so are most other people, right? So you'll just get angry with me when I mention that I've found some promising solutions to being fat (which makes you tend to get sick and die earlier than average), and I've also found that you're poisoning your body in a dozen or so ways.

There are some good reasons to believe that the Bioenergizer may help solve the fat problem. Certainly the Comby book will.

Continued on page 60

Carr's Corner

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It is very difficult to get an antenna working properly without making some simple measurements. Although it would be nice to make azimuthal and elevation pattern measurements, those are beyond the reach of almost all of us. On the other hand, the "I worked [or heard] a guy on the other side of the world" type of measurement tells us little or nothing. Heck, during the peak of the sunspot cycle a breath of hot air on the antenna can be picked up on all continents. Little or nothing can be said about the antenna from working a single DX station. I recall one fellow back in the early 1960s (on the downslope of the sunspot cycle) who worked DXCC in less than a year using a 50-watt Heathkit DX-20 crystal-controlled transmitter feeding a three-band trap vertical. He made up for the lack of a loudenboomer blow-torch RF power amplifier and a large beam with more than a tad of operating skill.

There are some things about antennas that can and should be measured, however. For example, VSWR and the resonant frequency of the antenna are readily accessible. It's also possible to measure the impedance of the antenna feed point. Hams can measure the VSWR either with a special VSWR meter (often built into transmitters or antenna tuning units), or by using an RF wattmeter.

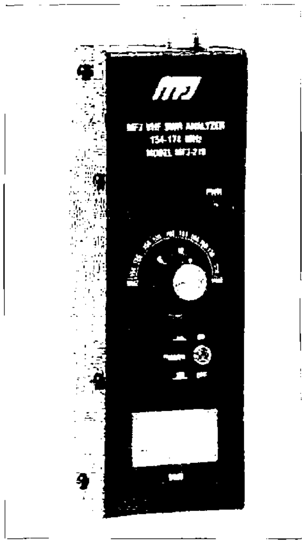

Photo A. VHF VSWR analyzer.

By stepping through the band and testing the VSWR at various frequencies, you can draw a VSWR curve (**Fig. 1**) that shows how the antenna performs across the band. The resonant frequency is the point where the VSWR dips to a minimum. You can use the resonant frequency to figure out whether the antenna is too long (resonant frequency lower than the hoped-for design frequency) or too short (resonant frequency above the design frequency).

But resonant frequency and VSWR curves are not the entire story because they don't tell us anything about the impedance presented by the antenna. You can't get the VSWR to be 1:1 unless the antenna impedance and transmission line impedance are the same. For example, a dipole has a nominal textbook impedance of 73 ohms, so it makes a very good match to 75-ohm coaxial cable. But the actual impedance of a real dipole may vary from a few ohms to more than 100 ohms—if your antenna exhibits a feedpoint impedance of (say) 25 ohms, using 75-ohm coaxial cable to feed it produces a VSWR = 75/25 = 3:1. Not too great. Measuring the feed-point impedance is therefore quite important to making the antenna work properly.

There are any number of instruments on the market that will aid in making antenna measurements. Some of them are quite reasonably priced (or can be built), while others are beyond the reach of all but the most ardent and well-endowed enthusiasts. In this column we will look at a newer breed of more universal instrument called the *SWR analyzer*.

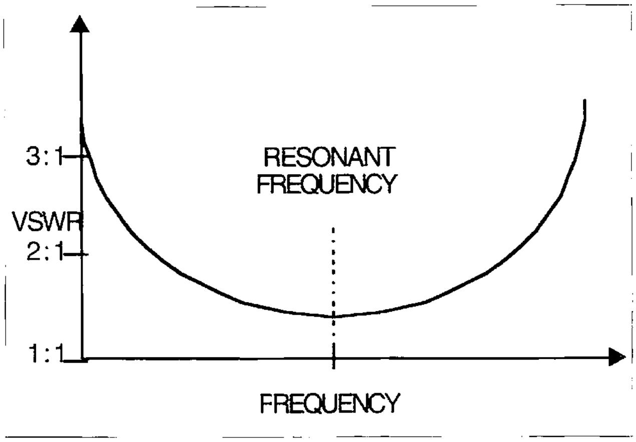

Fig. 1. VSWR vs. frequency curve.

VSWR analyzers

One basic premise in this column is that the instruments used for measuring VSWR must be accessible to people who don't have a ham operator's license,

> ***"Unlike many lesser SWR meters, this instrument is not fooled by antennas."***

as well as those who do (we must remember our SWL and scanner friends). Some of the instruments used by hams meet that requirement, but a relatively new breed of instrument called the SWR analyzer provides a lot of capability to the SWL, scanner operator and ham radio operator alike. It uses a low power RF signal generator and some clever circuitry to measure the VSWR of the antenna. One model also measures the feedpoint resistance.

The simple version shown in **Photo A** is for the high VHF band (154 to 174 MHz). It is a handheld battery-powered instrument made by MFJ Enterprises, Inc. (P.O. Box 494, Mississippi State, MS 39762). The meter reads the VSWR of the antenna at the frequency set by the TUNE dial. Alternatively, you can adjust the TUNE control until the minimum VSWR is found, and that is the actual (as opposed to desired) resonant frequency.

A somewhat more sophisticated instrument is the MFJ-249 (**Photo B**). This instrument combines a VSWR analyzer with a digital frequency counter, and operates over the range of 1.8 to 170 MHz. A bandswitch is set to the desired band, and then the TUNE control is set to the desired frequency. The meter will then read the VSWR at the design frequency. Alternatively, you can adjust the TUNE control until the minimum VSWR is found. This frequency is the actual, versus the desired, resonant frequency of the antenna.

An even more sophisticated version of this type of instrument is the MFJ-259 device (not shown). The front panel of the MFJ-259 has two meters: SWR and RESISTANCE. The SWR meter is calibrated up to 3:1, with a little uncalibrated scale to indicate higher SWRs. The RESISTANCE meter is calibrated from 0 to 500 ohms, which is

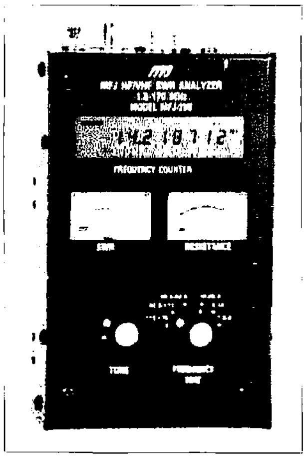

Photo B. MFJ-249 VSWR analyzer.

consistent with the SWR range. Two controls on the front panel are TUNE and FREQUENCY (MHZ) (a bandswitch). The MFJ-259 has a digital frequency meter to measure the operating frequency of the internal oscillator. This frequency counter can also be used to measure the frequency of external signal sources (*do not* connect the counter to the output of a transmitter—the instrument will be destroyed). The top end of the MFJ-259 has a number of controls and connectors. An SO-239 "UHF"-style coaxial connector is provided for the antenna connection. A BNC coaxial connector is provided to apply external signal to the frequency counter, while a push-button INPUT switch is available to switch the counter from internal to external signal sources. Another push-button switch is used to set the gate timing of the counter (a red LED on the front panel blinks every time the gate is triggered). The tuning is from 1.8 MHz to 174 MHz, while the counter will measure up to 200 MHz.

The MFJ-259 will work from an external 12 VDC source, or from an internal battery pack consisting of eight size-AA standard cells. MFJ recommends that either alkaline or rechargeable batteries, rather than ordinary zinc-carbon cells, be used in order to reduce the possibility of leakage that can damage the instrument (this is good practice in all battery powered instruments). I have a home-brew battery pack that uses eight size-D nickel cadmium batteries (4 Ah rating) that can be recharged from a 12 VDC power supply, and it works well with the MFJ-259.

Unlike many lesser SWR meters, this instrument is not fooled by antennas that have impedances consisting of both resistance and reactance elements. An example in the manual demonstrates an impedance of 25 + j25 ohms (i.e. R is 25 ohms and reactance, X, is also 25 ohms). When connected to a 50-ohm load one might be tempted to think the VSWR is 1:1, and some cheaper meters will so indicate. But the actual SWR is 2.6:1, which is what the MFJ-259 will read.

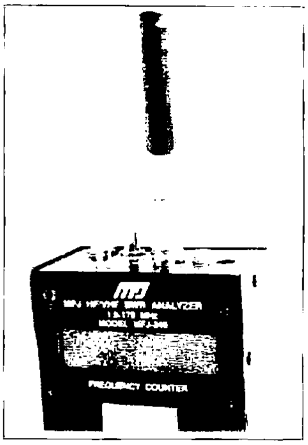

***Photo C.** MFJ-249 with dip meter adapter.*

The resistance measurement assumes a resistive load (the measurement is made at the antenna's resonant frequency), and is referenced to 50 ohms. The VSWR and resistance measurements should be consistent with each other. If the VSWR is 2:1, then the resistance should be either 100 ohms (100/50 = 2:1) or 25 ohms (50/25 = 2:1). If the resistance is not consistent with the VSWR reading, then you should assume that the impedance has a significant reactive component and take steps to tune it out.

In addition to antenna measurements, the MFJ-259 is equipped to measure a wide variety of other things as well. It will measure the velocity factor of transmission line, help in tuning or adjusting matching stubs or matching networks, and measure capacitance or inductance and the resonant frequency of L-C networks.

Photo C shows an MFJ-249 equipped with the MFJ-66 dip meter adapter. It can be used to make the MFJ-249 or MFJ-259 work in the same manner as a dip meter. Using this adapter allows you to measure the resonant frequency of tank circuits using the dipper approach, as well as to measure things such as the coefficient of coupling between two L-C circuits, transformers and other radio circuits.

Connections ...

I can be reached at P.O. Box 1099, Falls Church, VA 22041, or via Internet E-mail at carrjj@aol.com. 73

Number 56 on your Feedback card

HAM TO HAM

Your Input Welcome Here

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I'd like to thank all the contributors who've made the first year of "Ham to Ham" possible, and as we embark on the second year of the column. I invite all readers to keep sending in their favorite tips, ideas, suggestions, and shortcuts. Without your input, we couldn't continue to achieve our goal: many ideas passed on from many hams to many other hams, not just my own soliloquies. Having said that, however, here is one of my own "inventions" that I thought you might like to hear about, but you needn't stop there. Feel free to go ahead and make one for yourself.

Just the right tool!

It's often been said that having the right tool for the job is half the battle. It's also true that a good assortment of tools is something that every ham and electronics hobbyist needs to enjoy the pastime to its fullest. Even today, when most of us buy many things ready-made, there are still those times when we have to build those little extras that no one else seems to offer.

I've built any number of these electronic accessories over the past 40 years in the hobby, but this tip isn't about building an electronic circuit (not exactly): rather, it's about making a tool that will help you build electronic projects.

I know you're thinking, "make my own tools ... no thanks!" Well, I'm not usually the type to consider making my own tools, either—that's definitely not my primary interest in electronics—but this tool is different. Follow along and you'll see why. Plus, it's not all that difficult to fabricate—otherwise I certainly wouldn't have been able to do it! I've never seen one like it offered by any of the manufacturers who normally supply tools to the electronics hobbyists market so, as such, it qualifies for my own personal test of build-or-buy, which is: "If it's already made, I'm probably better off just buying it, but if it's not, then perhaps I should consider making one myself!"

Like most hams, I find myself using lots of the 1/8" (3.2 mm) miniature and 3/32" (2.4 mm) subminiature phone jacks on all sorts of different projects. These are the common panel-mount variety of small phone jacks sold by Radio Shack™ and others for bringing audio—and any number of other signals—into and out of a piece of equipment.

They're great: they're inexpensive, they do the job, and they're easy to wire. The problem I've always run into, however, is in how to tighten down those tiny slotted nuts that are used on these jacks, so that they aren't ruined functionally or in regard to appearance. Sound familiar? Most of us simply end up using a pair of ordinary pliers, or perhaps a very small straight-blade screwdriver, in an awkward attempt to tighten down the tiny mounting nuts on these little jacks. I almost always ended up marring the slotted nut itself, or the panel behind it, or both! I've done a pretty good number on some of these over the years ... but not anymore!

I've found it best to sit back and try to imagine what the perfect tool for the job would be.

That approach usually works, and when thinking about this one, I came up with what I call the Slotted-Nut Tightening Tool. It's shown in **Fig. 1** and **Photo A**.

Here's what I had pictured: The slotted nuts used on these jacks would require a tool of the correct diameter, with the correct size of mating pins (or projections) built into its end. It would have to be made of a material that's harder than the material that the nuts themselves are made of, and it should be reasonably easy to grip. With these parameters in mind, I began to develop the two tools shown.

Oh, that's right, you'll actually need two tools—one for 1/8" jacks, another for the 3/32" variety—but the 1/8" one is probably most often used, so we'll start with it (the 1/8" tool can also be used on some miniature toggle switches that use the same type slotted-nut mounting). Most of the information supplied here will apply to the smaller diameter 3/32" tool as well.

The slotted nuts used on the miniature panel jacks appear to be made of a nickel-plated brass. The first prototype tool that I made for myself was also brass, but I wouldn't recommend using a material that soft for the finished tool because it's too easily damaged—that particular one was strictly a prototype. Once I had proven to myself that the tool dimensions were correct, Bud Hollibaugh, a friend who's also an accomplished machinist, made several more for me out of steel. These have proven to be very serviceable. Tool-hardened steel isn't really necessary; just garden variety steel is fine, since those slotted nuts you'll be using it on aren't made of a very hard material.

Following the dimensions shown in **Fig. 1**, the steel rod should be about 5" long for an easy grip and good control. It's made of 5/16" (.3125") diameter steel rod with a 5/8" long 7/32" (.221") hole drilled directly in the center: this can be the tricky part. If you can locate a section of hollow steel tubing with these dimensions instead—such as steel fuel line tubing—it will make the job much easier for the average home constructor. Solid rod perhaps has a little bit better "feel" to it, since it's heavier, but tubing will work just as well.

Filing or grinding down one end of the tubing, so that two "male projections" remain, is the only other critical part. Take your time. Following the dimensions in **Fig. 1**, with the tool clamped tightly in a bench vise, you should have little trouble matching up the projections on the new tool with the slots on an 1/8" panel-jack nut.

That, of course, is the final determining factor: to make the tool mate as closely as possible with a representative sample slotted nut.

The remainder of the tool's "handle" can be covered with rubber tape, heat-shrink tubing, appropriately-sized cable jacket, or whatever you might have, to add some "grip" and "cushion" to it. If you have or know someone who has a lathe, a knurled handle gives it a professional touch.

In everyday use, the slotted nut is started onto the jack with your fingers, as you've no doubt always done, and only the final tightening, for installation or for initial loosening for removal, is accomplished with your new tool. It works like a charm, and like so many things, you'll wonder how you did without it for so long!

A variation, in the interest of simplicity, was to take a fairly wide, flat-blade screwdriver and simply notch out the material from the center of the blade, leaving two projections that fit over the slots of the slotted nut. It works, but doesn't seem to work as well as the tool described in the main body of the article—it can slip off too easily and damage the nut or the panel.

In my own experience, I've found that using the suggested configuration shown in **Fig. 1** works best, and then one tool for each individual size of phone jack: one for 1/8" and another for 3/32" jacks.

This is the sort of item that you'll probably only ever need one of (for each size), and it should last nearly forever if it's made as shown. You'll thank yourself over and over again in the future for spending the small amount of time needed to make one of each of these now.

I must reserve the copyrights on multiple quantities of the tools shown here and for their commercial manufacture and marketing,

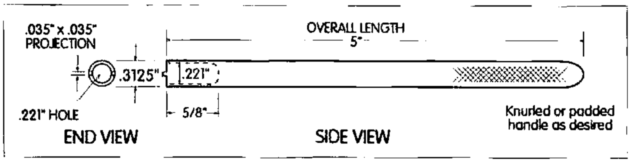


Fig. 1. End and side mechanical views of the Slotted-Nut-Tool© used for 1/8" miniature panel phone jacks. For the 3/32" Slotted-Nut-Tool, the hole (shown as .221") is bored to .144".

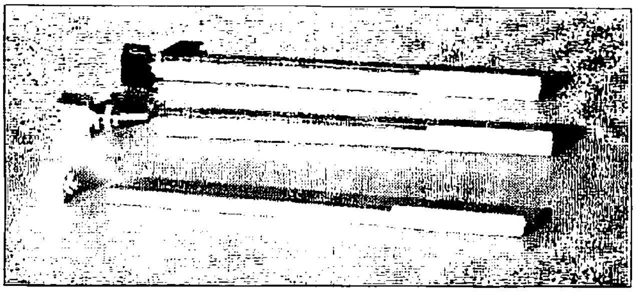


Photo A. From top to bottom: the 1/8" tool with phone jack nut; a 1/8" tool with an SPDT toggle switch nut; and a 3/32" with a subminiature phone jack nut.

but readers of this column should feel free to duplicate individual pieces for their own personal use.

Measuring upl

Speaking of tools, here's one from Peter Bergman NØBLX of Brainerd, Minnesota: "The US has been very slow to accept the metric system, yet in ham radio circles we use metric terminology daily. For measuring wire antenna lengths and coax cable multiples, I often thought that it would be nice to have a tape measure that read out in both metric and English graduations. I found one, from Stanley Tools of New Britain, CT. I have one of their No. 30-575 (7.5-meter/25-foot) steel tapes, and have my eye on their No. 34-827 PVC coated Fiberglas™ 30-meter/100-foot jobs. Santa, take note!

"Most 'super home centers' don't seem to carry metric tapes, but if several radio club members can get together on a single order, you might try one of the smaller, family-owned hardware stores to see if they can special-order some of the Stanley tapes, or the metric replacement blades, that are shown in Stanley's catalog. Your next antenna project could go much more quickly, when you're confident that everything has been measured correctly."

Moderator's note: I have an inexpensive 25-foot locking power tape made by Trophy (their No. 21925/T) that has continuous markings in centimeters, as well as in feet and inches, and Peter is right, it does make measuring for ham radio related cuts a good deal easier.

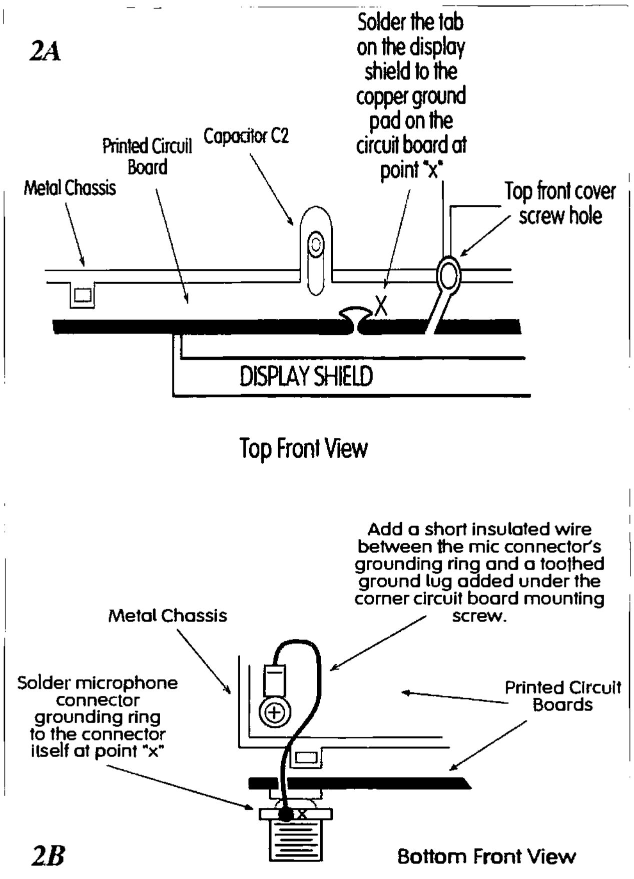
Well grounded ... continued

Last month, I talked about improving the RF grounding properties of ham equipment enclosures and covers, and I referred to the Alinco DR-1200T as an example. I picked it (as opposed to picked *on* it) because I own a couple of them, and have had the opportunity to work on a couple of small problems I've run into. I noticed that in the wintertime in Illinois, when the air is very dry, the high-voltage static buildup that can be generated by sliding across an automobile's synthetic seat cover can cause the DR-1200T to "reset" its memories when the mike connector is touched. Fortunately, it didn't do any more damage!

When I examined the mike connector grounding technique inside the radio, I felt that it might be improved by taking a couple additional steps. Those steps are shown in **Figs. 2A** and **2B**.

First, place a dab of solder on the display shield tab, looking at the radio's top, on the control printed circuit board, rather than depending upon mechanical grounding connections only (see **Fig. 2A**). Don't overdo this step; you may need to remove the shield sometime in the future, and it's not a good idea to go overboard!

Next, from the bottom of the radio, solder the microphone connector grounding ring to the shell of the microphone connector itself. The nickel plating on the connector should be scraped off at the point of soldering, and a small amount of solder paste used, to ensure a good alloy bond. Also shown in **Fig. 2B** is an added short-insulated wire from the microphone connector grounding tab directly to the circuit board's corner (ground) mounting screw, via a toothed soldering lug. This eliminates any ground impedance



Figs. 2A & 2B. *Alinco DR-1200T anti-static modification.*

in the traces on the control PC board, and permits any static discharge to take the shortest possible path to chassis ground.

These two easy modifications should help to protect your DR-1200T's "innards" from unexpected zaps from the outside; at least they did on mine.

The great equalizer

From William Thim N1QVQ: "If you find an inexpensive audio equalizer at a garage sale, flea market or hamfest, latch onto it and try inserting it between your transceiver's audio output jack and an external speaker. It can make a world of difference in improving the intelligibility of many signals you'll run across on the ham and shortwave bands.

"Since the human voice centers around the 1,000 Hz mark, bring that control up first, then adjust the other equalizing bands for the best clarity of overall sound. You can often eliminate much of the noise or other disturbing background, while accentuating the intelligibility of the speech range. The more bands the unit has, the better. It won't replace a good DSP for noise and heterodyne reduction, but it can make a difference on a minimum budget."

Moderator's note: If you do have a DSP, try an audio equalizer after it (as I have) and you'll probably find that it enhances the DSP's audio as well. Often, too, a second speaker located in another part of the room will make some signals "pop out of the mud" better than a single speaker. Varying room acoustics, and your own hearing "curve," make experimenting with various speakers and equalizer settings an inexpensive, intriguing continuing project.

Warm up your rotor

From Richard Mollentine WAØKKC: "An antenna rotor may bog down due to the grease on the gearing stiffening up with low temperatures. We cold-weather hams often have to wait for warmer, sunny days to coax our rotors into turning again! Working that weak DX station off the back of the beam isn't necessary anymore if you install a magnetic automobile engine-block heater on the bottom gearcase of your rotor's housing now, during nice weather.

"The unit that I'm referring to is sold at many auto parts stores or via the popular JC Whitney/Warshawsky catalog and is in the $18-$25 range. It has a powerful permanent magnet on its base and a length of 120 volt AC cord for powering the heating element from a standard wall outlet. Simply stick it to the bottom portion of your rotor's casing and run the AC cord to a switched outlet. It will heat up your rotor's gearbox to a 'toasty' temperature in only 20 to 30 minutes ... just don't forget and leave it on when the outside temperatures rise much above freezing!"

Moderator's note: Nice idea, Richard. In my own case, the housing on my antenna rotor is a non-ferrous casting, so a magnet-mount won't work, in and of itself. It could, however, be strapped to the rotor's base using an aluminum strap or two, or roof-eave and gutter exterior heat tape can be neatly wound around the rotor's base to warm up the rotor's gearbox in sub-freezing temperatures. You may have to experiment a bit with the idea to get it just right. Remember, however, don't get too close to the rotating top portion of the rotor housing or allow the rotating portion to rub against the heat tape, the engine block heater, or its AC cord. Be careful to follow all proper out-of-doors electrical practices if you need to extend the heater's AC cord or when plugging the heater into an exterior outlet. A ground-fault interrupter outlet may be required by your local codes; please don't try to do without it. Even if the GFI tends to trip when you're on the air, your rotor's gears will probably be warm enough to turn easily for that particular ham radio session.

S-meter readings exposed

From Klaus Spies WB9YBM: "The following S-meter value table shows the correlation between actual signal strength in microvolts at the antenna terminals of a properly calibrated receiver vs. the S-unit reading on that receiver. Note that there is an older 'ham' standard, and a newer 'world' standard. Both values are shown in **Table 1**.

"Some of this information was heard on the 'Voice of Japan' in March of 1994, the rest was calculated from their 6 dB per S-unit specifications."

Moderator's note: Each S-unit is 6 dB more as you go up the scale from S1 to S9. 6 dB represents a doubling of the voltage, but it takes four times the power to do that. To go up two S-units, the transmitting station would have to increase its power from 100 watts to 1600 watts, or 100 watts over the legal limit! That, of course, is assuming that the receiver's S-meter is right on the money. That's why it's difficult to put too much credence on some of the reports received over the ham bands. This is another of Klaus' handy tables that you might want to clip and paste somewhere over your workbench or at your operating position.

The importance of self-control

From Peter Albright AA2AD: "The primary purpose of a voltage regulator in a power supply, whether it's in an external, separate supply or in the ham

"S" Units	Old "Ham" Standard	Newer "World" Standard
S9	50.00uV	40.00uV
S8	25.06uV	20.04uV
S7	12.56uV	10.04uV
S6	6.29uV	5.03uV
S5	3.15uV	2.52uV
S4	1.58uV	1.26uV
S3	.79uV	.63uV
S2	.39uV	.31uV
S1	.19uV	.15uV

Table 1. *Two current standards of S-meter readings relative to microvolts of input signal to the receiver.*

Photo B. Chuck Wilson N6MUJ's "Sticky 2M Antenna" on the inside of his car's rear window.

transceiver/receiver itself, is to provide a source of stable, consistent voltage, either for reference or for powering the circuitry directly. Some circuits function quite well without power supply regulation and can afford to take power directly from the output of a power supply's output filter network, while others demand a more stable voltage or current for proper operation. It's always best to assume that the equipment designer knew which his equipment needed, and take any necessary measures to correct regulation problems that may develop, as soon as they're noticed.

"There are several symptoms that can indicate a faulty or defective power supply regulation circuit. If a short exists in the regulator, the fuse will generally blow, even though other sections of the power supply circuitry may be functioning normally—some devices use a so-called 'crowbar circuit' to blow the fuse deliberately in the event of an overvoltage condition. More commonly, however, voltage regulators tend to open, failing to supply their regulated output; only rarely, in very basic regulator circuits, do they supply full, unregulated output voltage (which is fortunate, since some circuits wouldn't tolerate the full unregulated output without developing additional problems). For that reason, don't be tempted to bypass a failed regulator unless you're absolutely sure of what you're doing.

"Here, then, are the common regulator configurations that might be found in ham power supplies and within the destination equipment itself:

"The simplest regulator is a zener diode—in series with a current-limiting resistor—from the power supply's output line to ground. Zener diodes begin to conduct at a set voltage, so that any excess voltage will be shunted to ground across the current-limiting resistor, and the diode itself, by brute force. Simple shunt zener regulators like this are for low-current demand applications only, and they provide no overvoltage protection in the event of a failure of the diode or its limiting resistor.

"To enhance the current-carrying capacity of the simple zener regulator, it's common to use the diode as part of the base circuit of a higher-powered 'pass' transistor, with the primary current flow between the emitter and collector of that transistor, and the zener acting strictly as a low-current control element in the transistor's base. 'Pass' transistors are generally mounted on a heat sink for greater heat dissipation capabilities and can be paralleled, with appropriate equalizing resistors, for even greater current-handling ability.

"Voltage regulators are available in handy-to-use integrated circuit packages, ranging from the simple three-terminal packages, available in both fixed and variable voltage outputs, that we've all seen (and perhaps used), to multi-pin programmable ICs. A fully automatic battery charger with voltage sensing capabilities would be one example of the latter (like the one that I recently built for my own needs).

"Just in case you're into 'older' wireless, I should briefly mention the 0A2 and 0B2 series of gas tube voltage regulators that might be found in some of these sets. They function in a similar manner to the simple zener shunt regulator circuit mentioned first, and are also strictly low-current regulators. The pleasant pink-blue color is unmistakable in the back of a tube-type rig, when 'real' radios had to glow to be working!"

Moderator's note: Peter does a nice job (as always) of explaining the basic voltage regulators to be found in today's ham power supplies. It's safest to disconnect the circuitry that's being fed the output of the supply when repairing and initially testing the defective voltage regulator circuit. The regulator, if it's doing its job, should put out very close to its correct voltage with or without a load on it, and if it isn't, at least you might prevent further damage to the secondary circuitry. Also, as Peter mentioned, the present-day line of IC regulators is generally very handy, but be sure to follow the recommended input/output capacitor bypassing, along with any other special considerations, as stated by the manufacturer of the device. Regulator "chips" can oscillate under certain conditions, and in addition to not doing their job properly, can be a tough problem to troubleshoot.

A sticky antenna idea!

From Chuck Wilson N6MUJ: "My 1995 Volvo wagon came from the dealer with an antenna for the AM/FM radio stuck to the inside of one of the rear windows. In an attempt to maintain the no-outside-antenna appearance of the vehicle, I decided to try the same approach for a 2 meter antenna on the opposite inside rear window. I used two 19-inch lengths of 1/2"-wide adhesive-backed copper ribbon, formed in a V shape, opened at the bottom of the V, and fed with 50 ohm coaxial cable, as shown in **Photo B.** and **Fig. 3.** I was able to easily access the repeater some 15 miles away from inside my garage, with just my HT and my new V antenna inside the car.

"I later replaced the 2 meter HT with a dual-bander, and the same antenna works well over the same distance on 440 MHz. I'm not sure what the SWR is—and I'm not sure that I want to know—but I do know that it works and that's really the bottom line, especially when I found that I could hit the same repeater from 40 miles away and from behind the hills that block its 'radio view.' It's an idea you might want to try if the XYL says 'negative' to an outside antenna on the new family buggy!"

Moderator's note: The self-stick copper foil that Chuck mentioned is often available from craft supply stores that cater to stained-glass makers. The foil is used to hold the glass pattern together during assembly. It comes in several different widths and roll lengths. The advantage of using copper vs. aluminum-foil tape is in copper's ease of soldering and greater tensile strength.

If you have trouble locating it, Radio Shack sells 3/8" wide self-adhesive window "alarm" foil (cat. #49-502) and self-adhesive

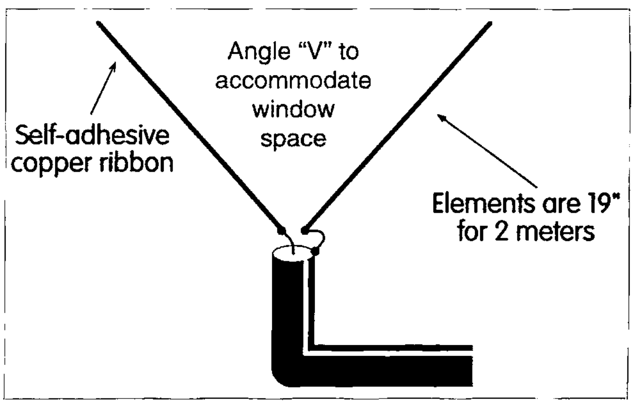


Fig. 3. N6MUJ's "Sticky Antenna."

foil connectors (cat. #49-504), that might be worth trying. By the way, 440 MHz is the third harmonic of 146 MHz, but a separate V for the 440 band, with about 6 3/4" of conductive tape in each leg, would most likely give even better results on that band. I would also only use low power—under 5 watts—into an antenna of this nature, both from an RF-in-the-car standpoint and from the standpoint of possible mismatch stress on the radio itself. I wonder how much the SWR would change with rain, ice, or snow on the windows?

VHF harmonic bug spray

From Richard Measures AG6K: "Here's the solution to a problem that's often caused by VHF harmonic energy leaking out via the external cabling from your transceiver. If you experience TVI from your amateur transceiver, even while transmitting into a well-shielded 50 ohm dummy load, this may well work for you. Try adding one or two VHF attenuator ferrite beads over each of the two active wires (hot and neutral) that make up the 120 volt AC line input.

"Just in case you haven't used ferrite beads before, they do not have to be in metal-to-metal contact with the wire that they're filtering to be effective, and in the case of the AC line cord, they definitely should not be. These ferrite products work by 'choking' the RF energy that's attempting to pass through the wire, and need only be around the wire's insulated outer covering to function correctly. The beads are generally rod-shaped, with a center hole large enough to pass the insulated wire completely through the bead's core, so the insulated AC wire is simply separated and strung through the bead.

"It may also be helpful to add a 470 pF, 1 kV disc-ceramic bypass capacitor from the AC line side of each bead to ground. Replace any two-wire AC line cord with a three-wire grounding cord, connecting the 'green' or ground terminal of the new cord to the transceiver's chassis ground. This provides a low-impedance ground-return path for both the unwanted harmonic energy and the small 60 Hz AC current that flows through the bypass caps. If any exposed 120 volt AC connections exist within the radio when implementing this cure, be absolutely sure that they are contained within an insulated, well-marked covering of some sort."

Moderator's note: Ferrite beads and choke cores are available from Radio Shack retail stores nationwide (#273-104 and #273-105), All Electronics (Tel: 1-800-826-5432), Amidon Associates (Tel: 714-850-4660), Palomar Engineers (Tel: 619-747-3343), as well as from other sources. 1 kV disc caps are obtainable from All Electronics and from Digi-Key Corp. (Tel: 1-800-344-4539). All Electronics and Digi-Key also carry a number of pre-made, packaged RF line filters at a slightly higher cost than doing-it-yourself, but they're often much easier and safer to use. Sometimes, simply wrapping a few turns of the AC line cord through a ferrite toroid core of sufficient diameter is all that's needed to quench VHF harmonics emanating from an amateur transceiver; try that as well. Other input/output cables to your transceiver might also benefit from being passed through a ferrite choke or core to suppress both in-band and out-of-band energy. It's very often a try-it-and-see situation.

And this ends another month of "Ham To Ham." Thanks to all who've submitted their tips, ideas, suggestions, and operating shortcuts—you're the ones who make the column work. Let's hear from more of you ... the more input I have, the better the results, and the more we can expand the column's scope in the future. Send whatever you would like to pass on to the address above; sending them to *73*'s offices in Peterborough directly only delays their use here.

As always, many thanks to this month's contributors:

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Please send all correspondence relating to this column to *73's* Ham To Ham column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

NEVER SAY DIE

Continued from page 53

And now I've run across another approach that looks just about surefire, and doesn't depend on your almost totally unused determination. Look for a paperback by Dr. Arthur Coca, *The Pulse Test*. Spend the lousy five bucks. With this little book you'll learn how simple it is to find out what you're allergic to just by taking your pulse. And when you avoid allergens your fat melts away, as does arthritis. It's ISBN 0-312-95699-1, published by St. Martin's Press.

I don't know how much of the stuff in my bulging health literature file really works, but I'll keep reading and talking with people in the field I trust so I can report to you on what looks most promising.

Coca claims that when you stop dosing your system with things you're allergic to, it can stop tobacco and alcohol addiction. Look, you already know that no two people are exactly the same, so it shouldn't be a news flash that we all have different allergies. Most of mine got triggered by childhood immunization shots, so I've had a life of hay fever and asthma from dogs and cats. Eating watermelon stops my vocal cords from working and sure raises my pulse.

All you have to do is measure your pulse several times a day. Mine rests at 60 per minute. Then you eat, drink, or breathe something and measure your pulse 30 and 60 minutes later and see how much it goes up. If it does, you've found something you should avoid. Well, read the book, which was first published 40 years ago.

Déjà Vu

There's a remarkable parallel between the beginning months of the personal computer and cold fusion. It's almost enough to encourage anyone with spunk to head for the cellar or garage and start experimenting.

Since I was there from day one of the microcomputer revolution and, maybe helped it to get started with my magazines and proselytizing, I know how it was.

When the MITS Altair 8800, the first microcomputer, was introduced to the market back in January 1975, the computer professionals looked at it and ridiculed it as a toy, and not worth even thinking about. This attitude was fanned by *Computerworld*, the main publication in the computer field. It made fun of microcomputers, doing its best to put them down as of no interest or value to true computer professionals. It's my belief that this publication was largely responsible for the destruction of virtually all minicomputer companies, eventually putting tens of thousands of people out of work. It helped companies like Wang, DEC, Prime, Data General, and hundreds of smaller firms miss the

Continued on page 71

Number 61 on your Feedback card

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
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Foxhunt day, step by step

Is your foxhunt scheduled yet? Last month's "Homing In" led you through the process of planning and promoting an international-rules radio direction finding (RDF) contest. Foxhunts are a mainstream ham activity in Europe and Asia, but they won't gain a toehold here until more ham clubs and conventions get busy and sponsor them. It's great fun, and it might start a new tradition for your club's hamfests.

August's column covered advance work, including site selection, transmitting gear, promotion, education, and registration. My recommendations are based on experiences of the Southern California Six Meter Club (SC6MC), which sponsored foxhunts at the ARRL Southwestern Division convention (Hamcon-95) and the West Coast VHF/UHF Conference (VHF-96). This month, we'll cover what happens on hunt day.

Special punches

Fox transmitters are concealed and unattended. Therefore, judges need a method of proving that the hunters find each fox. World Championship foxhunts employ a "punch" method, established by orienteers, that we've adopted (see **Photo A**). Orienteers verify that competitors visit the required checkpoints by having a special punch at each point. Each punch has a distinctive pattern with up to nine pins. Competitors carry a card with numbered spaces for punching. Cards and punches can be bought by mail from outfitters such as J. Berman Orienteering Supply, Post Office Box 460, Sunderland MA 01375; (413) 665-7822. Twenty different punches are available; purchase as many as you need for less than three dollars each. Berman also sells Silva orienteering cards by the hundred.

Ukrainian hunts feature special machines at each fox that timestamp the cards, much like punching a time clock. This would be important if rules demanded that the foxes be located in a particular order, but such is not usually the case. However, it is mandatory that hunters punch numbered spaces on the card correctly. The punch at fox #1 must be used to mark square #1 on the card, and so forth. Be sure to announce this requirement before the hunt; it was a source of contention at VHF-96. Some hunters were unaware of the rule and marked square #1 with whichever punch they found first, etc.

I like the special punches, but you don't have to use them. For practice hunts before I got the punches, I made up slips of paper with fox numbers printed on them to give to the hunters at the start. I put a different colored pen or pencil at each fox, which they used to circle the appropriate numbers.

It takes a team of volunteers to put on a well-run foxhunt. You will need timers at the starting line to send off the hunters at exact intervals, plus helpers at the finish line to collect the cards and mark finishing time on them. Things can get hectic at these two locations, so two persons are better than one. Remember, these positions do not require licensed hams.

Name	Call	Team	DOB	Age	Div	Wave
Cloth, Terry	KOOVX	ARES	1/4/84	12	Y	1
Foolery, Tom	WE6ABC	PODUNK	8/4/80	15	Y	4
Camel, Joe	KG6ABC	PODUNK	11/26/73	22	P	2
Upendown, Bob	KZ6YY	RACES	6/29/65	30	P	3
Transmission, Emanuel	N6FSL	PODUNK	12/1/64	31	M	1
Gallery, Art		ARES	10/2/56	39	M	2
Love, April	WA6AA		6/6/50	45	M	3
Dressed, Natalie	WA6JFP	RACES	4/6/48	48	S	1
Tickly, Fran		RACES	3/19/45	51	S	4
Sez, Simon	W6XYZ	ARES	3/16/41	55	S	3

Fig. 1. A sample spreadsheet sorted by age. I'm sure our contestants don't want their birthdays listed in a widely-read magazine, so these are some made-up names.

Have Course Marshals scattered in the woods to watch over the activities. Contestants know they should not help one another in any way or vandalize the foxes, but having Marshals helps prevent temptation. Marshals should also be on the lookout for any health problems that might develop during the hunt. Don't station them near foxes—that would be a giveaway. Have them keep moving along. Encourage them to carry cameras to document the fun for your club's newsletter or Web page. They can also serve as judges to check over the results before prizes are awarded.

The Region 1 ARDF Working Group requires starting corridors between 50 and 250 meters long at championship events. Competitors run into the corridor when instructed by the start timers. When they reach the end, they may turn on their RDF gear and take off into the forest. The end of the corridor should not be visible from the start point.

One purpose of a corridor is to prevent those waiting at the starting line from seeing which way hunters go. This is particularly important if the start point is in the middle of the venue. Rather than try to put up curtains or fences, try to find a natural corridor at your site. At VHF-96, we put the start point at the northwest corner of the park. Starters went over a small footbridge, up a hill, and disappeared into the woods—an ideal starting situation. At the Hamcon-95 hunt, we used a 50-yard walkway between two buildings.

Depending on your site, the finish line can be next to the start or at another location where family members can wait (and perhaps picnic). Mark the end point clearly on the course map. At international meets in very large forests, a transmitter on a separate frequency beacons regularly from the finish area. At our hunts, the finish line beacon frequency doubled as an emergency calling frequency, monitored by the finish line attendant. Hunters were forbidden to transmit on the hunt frequency. Note that competitors are not required to locate the exact placement of the finish line transmitter; no punch should be placed there.

Photo A. J. Scott Bovitz N6MI attaches an orange orienteering punch to a well-concealed fox transmitter at VHF-96.

International Amateur Radio Union (IARU) rules call for an ending corridor of 50 to 100 meters leading up to the finish line. I think an ending corridor is unnecessary, but you may want to have one if there are some elite runners and you're worried about a "photo finish." In any case, be sure your finish line or corridor is well marked.

Bring your laptop

While you might prefer to announce age divisions in advance, we decided to wait until all registration was done. Then we chose division breakpoints and individual start times to even up the field. Upon registering, each hunter gave his/her name, callsign, date of birth (DOB), and team affiliation, all of which went into the computer.

Although I don't know of any software dedicated to foxhunt or orienteering competitions, I found that a spreadsheet program with date/time and sort capabilities works just fine. I chose Microsoft Excel for Hamcon-95 and VHF-96. After registration was complete and all hunters were entered, one person per line, I sorted and printed the data by name. This printout would be posted at the site and each hunter would be asked to verify that his/her data was correct.

Next, I sorted and printed a listing by age (**Fig. 1**). The committee used this sort to select age division breakpoints. The goal was to be fair from an abilities point of view, but also to avoid any division having many more competitors than the others, which would unduly extend the starting process. For both hunts, our divisions were Youth (17 and under), Prime (18 through 30), Masters (31 through 45), and

Name	Call	Team	Div	Wave	2:12	Start	Finish	Time	T's	Rank
Printz, Wes	KA3DSE	DARC	M	1	2:15			######		
Schwendtner, Dennis	WB6OBB	SBARC	S	1	2:15			######		
Probert, Matthew	KE6JRR	SBARD	Y	1	2:15			######		
Reginato, Nerella			M	2	2:18			######		
Heather, Elizabeth	KC6OFS	DARC	P	2	2:18			######		
Hare, Ed	KA1CV	ARRL	M	3	2:21			######		
Mendenhall, Matt	KE6ALM	SGVRC	P	3	2:21			######		
Goddard, Art	W6XD	ARRL	S	3	2:21			######		
Reginato, Reg	KE6ZQY	SBARC	S	4	2:24			######		
Mirabella, Tom	KD6AAN	OCRACES	Y	4	2:24			######		

Fig. 2. First part of the start sequence spreadsheet, sorted by time. One competitor in each division starts in each wave. Age and DOB columns have been hidden.

Seniors (46 and over). To the spreadsheet, I added Division, Wave, and Start Time columns and entered the division designations when they had been decided upon.

Now it was time to determine the starting order. One to four hunters would start at a time, always from different divisions. The number of start times (waves) equals the number of competitors in the category having the greatest number.

Just as players are "seeded" in tennis tournaments, start times should be chosen with the anticipated abilities of the hunters in mind. Slowest hunters should start first, fastest last. This gets the event over sooner, so everyone can find out the results in a timely manner. Family members should not start at the same time; youth should go out early, parents later. This way, the kids are less likely to look for their parents on the course. We tried to separate family members and regular T-hunting partners by at least four waves on our hunts. We also avoided starting members of the same team in the same wave.

We chose three-minute starting intervals in the VHF conference hunt. With 11 waves and a two-hour time limit, the maximum event time would be two-and-a-half hours from first starter to disqualification time for the last starter. Since there were to be six foxes, half of the runners would start on fox #1 and half on fox #4. Some would say it is more fair to start at six-minute intervals (all on fox #1), but then the event could take three hours. We didn't want to finish that late.

Once the wave numbers and a dummy pre-start time were entered in the spreadsheet, Excel calculated the scheduled start times for each competitor. I then did a sort by wave number, which gave a starting time lineup to be announced before the hunt. The printout of scheduled start times (**Fig. 2**) has added columns for Start and Finish. The Start column is there in case something goes wrong and the actual starting times end up being different from the scheduled times. If they turn out to be the same, it's easy to insert them in this column with the Fill Across command.

Be sure to allow plenty of time to get the hunt organized. Don't start the hunt until a full cycle of fox transmissions has been heard, so you'll know that all are working properly. Our VHF-96 entrants were sent from the assembly point to the site at 1 p.m. Guessing the time required to make announcements and get underway, I printed up sheets with scheduled times starting at 2 p.m., 2:15, and 2:30. Because of problems with the foxes, we ended up starting at 2:49.

As hunters arrive at the site, have them put all their RDF gear in the impound area. (We used a big blue tarp on the ground.) They are not allowed to pick it up again until one minute before it is their turn to start, and may not turn it on until they reach the end of the start corridor. Gather everyone around for instructions, rules, and announcements (see **Photo B** and the sidebar).

I think it works best to have two people at the starting table. One watches the clock and officially starts the hunters, while the other calls the hunters by name in advance and makes sure they're on deck before their times. Be sure that clocks at the start and finish points are synchronized. IARU requires that less than one second difference between these clocks be verified, and insists that competitors be allowed to check their watches against the starting point clock.

As hunters cross the finish line, the attendant takes their punched cards, marks exact finish time, and number of foxes found on the cards, then gives the cards to the scorekeeper. The spreadsheet will do the subtraction to get elapsed times. Once all start/finish times are entered, it's easy to find the individual winners with one "sort" command (**Fig. 3**). The first sort key is division, the second is number of foxes (descending), and the third is elapsed time (ascending). With another sort, you can find team winners: The first key is team; the second and third are as before. Once the judges verify the numbers, it's time to award prizes and certificates (**Fig. 4**).

When is the next one?

Whew! It's over! Another successful foxhunt! You may find, as we did, that everyone is having so much fun they're not ready to go home yet, although all the activity has made them hungry. For our hunts, we arranged for a group discount at a nearby restaurant for a "Dutch treat" dinner, to prolong the good times and plan the next hunt.

If you would like to try the spreadsheet scoring method, I will provide my sample Excel tem-

Rules, Rules, Rules

Important starting point announcements and instructions:

- Location of restrooms.
- Boundaries and forbidden areas, if any.
- No assistance on the course.
- Do not transmit unless an emergency occurs.
- Punch the right square for each fox on the card.
- No visitors on the course.
- Start times for each runner.
- Put your name and start time on your card.
- A lost card means disqualification.
- Verify your name, team, and DOB on the printout.

Name	Call	Team	Div	Wave	2:46	Start	Finish	Time	T's	Rank
Garrabrant, Byon	KD6BCH	OCRACES	P	9	3:13	3:13	4:11:24	0:58:24	5	1
Barrett, Rick	KEYDKF	SGVRC	P	10	3:16	3:16	4:18:37	1:02:37	5	2
Mendenhall, Matt	KE6ALM	SGVRC	P	3	2:55	2:55	4:39:54	1:44:54	5	3
Barth, Scot	KA6UDZ	SGVRC	P	11	3:19	3:19	5:06	1:47:00	5	4
Holland, Randy	KO6KC	OCRACES	P	7	3:07	3:07	5:01	1:54:00	5	5
Heather, Bill	KB6WKT	DARC	P	5	3:01	3:01	5:01	2:00:00	4	6
Heather, Elizabeth	KC6OFS	DARC	P	2	2:52	2:52	4:52:42	2:00:42	3	7
Allen, Glenn	KE6HPZ	DARC	M	11	3:19	3:19	4:53:50	1:34:50	5	1
Printz, Wes	KA3DSE	DARC	M	1	2:49	2:49	4:42:55	1:53:55	4	2
Hare, Ed	KA1CV	ARRL	M	3	2:55	2:55	4:49:57	1:54:57	4	3

Fig. 3. First part of the VHF-96 spreadsheet, as sorted for individual winners. Be sure to disqualify any hunter whose time is over the limit.

plate if you send a 3.5" Macintosh or PC disk and a self-addressed stamped envelope to the address atop this column. I am also posting the template at the "Homing In" Web site. My template was written with Excel version 4.0 for Mac, but other versions may be able to read and run it.

A "Homing In" Web site? Yes, at long last my RDF pages on the World Wide Web are up and running. By the time you read this, most of the construction should be complete, at least for Version 1. The main purpose of having a site for "Homing In" is to post answers to the frequently asked questions that

Fig. 4. Find a computer-savvy person in your club to make up nice certificates for team awards and non-trophy individual places. Ours were designed by Christie Edinger KØIU.

***Photo B.** Your columnist gives final instructions before the first VHF-96 hunter leaves the start corridor. (Photo by J. Scott Bovitz N6MI)*

I presently spend lots of time handling via E-mail or snail-mail. Even if you don't have an RDF question, the site is worth visiting because you'll find updates to my T-hunt book and a complete "Homing In" index, listing topics for over 90 columns. URL http://members.aol.com/homingin/ should get your browser there.

Of course your mail, postal or electronic, is still welcome. Please note my new ZIP code atop this column. Send e-mail to: Homingin @aol.com or 75236.2165@ compuserve.com.

Ham Radio Fun

Communications Simplified, Part 9

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As we mentioned last time, with more modulation, even more sidebands might be required to keep the amplitude constant. So we need to learn how to measure the amount of modulation. This can be done in two ways—using the deviation, or using a modulation index.

Deviation

Deviation measures how far the carrier swings from its center or unmodulated value. For example, commercial FM broadcast stations are allowed to deviate up to ±75 kHz from their center frequency. Thus a station on 96.3 MHz could swing its carrier down to 95.225 MHz (96.3 MHz minus 75 kHz) or up to 96.375 MHz. Police, fire, or ham FM radios, on the other hand, generally use ±5 kHz deviation.

Note how we said that commercial FM broadcast stations *are allowed* to deviate up to ±75 kHz. This is not a technical limit—it would be easy to build equipment which deviates a lot more. Rather, 75 kHz is a maximum limit imposed by the FCC to prevent interference with adjacent stations. Likewise, 5 kHz deviation is used by fire, police, ham, and other communications equipment to avoid interference with other users. So, unlike the case of AM where 100% modulation is a limit which you simply cannot exceed for technical reasons, the maximum amount of FM deviation is more of a "good neighbor" policy, usually enforced by the government.

Modulation index

The modulation index is the second way of measuring the amount of FM modulation. The modulation index (we will abbreviate it as *MI*, but there are several other symbols often used) is defined as:

$$MI = \frac{\text{deviation}}{\text{modulation frequency causing that deviation}}$$

For example, an FM station transmitting a 5 kHz audio signal (this is the modulation frequency) at a 15 kHz deviation would have a modulation index of 15/5, or 3.

You can see that, even if the deviation stays the same, the modulation index can vary all over the place. For example, if that FM station keeps the same 15 kHz deviation, but the audio frequency changes from 5 kHz to 50 Hz, the modulation index suddenly changes to 15,000 Hz divided by 50 Hz, or 300 (be careful to use the same units on both the top and bottom of the equation).

It's the modulation index that determines how many sidebands are needed to keep the amplitude of the FM signal constant. For example, if the modulation index is 0.2 or 0.3, then just one set of sidebands is needed; if the modulation index is 10, then 13 sidebands would be needed on each side of the carrier to keep the amplitude constant. The calculations to determine how many sidebands are needed at any given modulation index are fairly complex, and involve something called Bessel functions. To avoid all this work, most people use a table like Table 1, which

		Sideband												
MI	Carrier	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th	13th
0.0	1.00													
0.25	0.98	0.12												
0.5	0.94	0.24	0.03											
1.0	0.77	0.44	0.11	0.02										
1.5	0.51	0.56	0.23	0.06	0.01									
2.0	0.22	0.58	0.35	0.13	0.03									
2.5	-0.05	0.50	0.45	0.22	0.07	0.02								
3.0	-0.26	0.34	0.49	0.31	0.13	0.04	0.01							
4.0	-0.41	-0.07	0.36	0.43	0.28	0.13	0.05	0.02						
5.0	-0.40	-0.33	0.05	0.36	0.39	0.26	0.13	0.05	0.02					
6.0	0.15	-0.28	-0.24	0.11	0.36	0.36	0.25	0.13	0.06	0.02				
7.0	0.30	0.00	-0.30	-0.17	0.16	0.35	0.34	0.23	0.13	0.06	0.02			
8.0	0.17	0.23	-0.11	-0.29	-0.10	0.19	0.34	0.32	0.22	0.13	0.06	0.03		
9.0	-0.09	0.24	0.14	-0.18	-0.27	-0.06	0.20	0.33	0.30	0.21	0.12	0.06	0.03	0.01
10.0	-0.25	0.04	0.25	0.06	-0.22	-0.23	-0.01	0.22	0.31	0.29	0.20	0.12	0.06	0.03

Table 1. Carrier and sideband amplitudes (from Bessel functions).

actually provides more information than just the number of sidebands.

Let's look at an example. Let's assume we have an FM broadcast station which transmits a 4 kHz tone at a deviation of 2 kHz, giving us a modulation index of 0.5. For this modulation index, **Table 1** gives us the following information: MI = 0.5; Carrier = 0.94; 1st sideband = 0.24; and 2nd sideband = 0.03.

This tells us that there are two sets of sidebands on each side of the carrier: The carrier amplitude is 94% (0.94) of the unmodulated value, the first set of sidebands has an amplitude of 24% (0.24) of the unmodulated carrier, and the second set of sidebands has an amplitude of 3% (0.03) of the unmodulated carrier.

Notice that the carrier is now smaller than it would be if left unmodulated. Unlike in AM, where the carrier stays the same size no matter what the sidebands do, an FM carrier changes size as you modulate it. This makes sense when you realize that the total FM signal voltage and power (which consists of the carrier plus all the sidebands) has to stay the same all the time. When the sidebands appear, something else has to decrease to keep the total voltage and power the same.

Let's look at this in more detail. Suppose the original carrier (before modulation) was 10 volts rms, and was sent into 50 ohms. The total power would then be found from $P = V^2/R$ to be 2 watts.

Now let's see what happens with the modulation index of 0.5.

The carrier voltage is now 10 x 0.94 = 9.4 volts, and its power (still assuming a 50-ohm load) is: $9.4^2/50$ or 1.7672 watts, less than before.

The first sideband is 10 x .24 = 2.4 volts, and its power is: $2.4^2/50$, or .1152 watt. Remember, there are two of these sidebands (one upper and one lower), so their total power is twice that, or 0.2304 watt.

The second sideband is 10 x .03 = 0.3 volts, and its power is: $0.3^2/50$, or .0018 watt. Again, there are two of these sidebands, so their total power is twice that, or 0.0036 watt.

When we add all of these powers together, the 1.7672, 0.2304, and 0.0036 watt add to almost exactly 2 watts (the slight error is because **Table 1** gives the coefficients to only two decimal places.) So the modulated carrier has the same power as the unmodulated carrier.

	Voltage (volts)	Power Each (watts)	Total Power (watts)
Carrier	- 4	.3200	.3200
1st SB	0.7	.0098	.0196
2nd SB	3.6	.2592	.5184
3rd SB	4.3	.3698	.7396
4th SB	2.8	.1568	.3136
5th SB	1.3	.0338	.0676
6th SB	0.5	.0050	.0100
7th SB	0.2	.0008	.0016
Total power, carrier plus sidebands:			1.9904

Table 2. The sum of an FM carrier wave and its sidebands.

Let's try another example. Suppose the unmodulated carrier is again 10 volts, the load is still 50 ohms, the modulating frequency (which would be the audio in an FM broadcast station) is 1 kHz, and the deviation is 4 kHz, giving a modulation index of 4. **Table 1** tells us that the carrier has an amplitude of -0.40, and that there are seven sidebands, of which the first also has a negative amplitude. Since amplitudes can't be smaller than zero, what do the minus signs mean?

The negative amplitude here simply means that the phase has reversed, so the carrier and the first sideband both have opposite phases from what they were at lower values of the modulation index. As far as the power is concerned, this doesn't matter, so we can still add up the total powers as in **Table 2**.

Again, the total power is about 2 watts, with a slight error because the Bessel values are accurate to only two decimal places. So the total power of the FM signal doesn't change with modulation, although the power gets shifted around between the carrier and the sidebands.

Let's look at the negative numbers in **Table 1** one more time. At a modulation index of 2, the carrier had a value of 0.22, while at an index of 2.5, the carrier became -.05. Obviously, somewhere between 2 and 2.5, the carrier value went from plus, through zero, to minus. At the zero (which occurs when the modulation index is 2.405) the carrier completely disappears, and all the power is in the sidebands. This point is useful because it lets us calibrate a deviation meter—we observe the signal on a spectrum analyzer and increase the deviation until the carrier disappears. Of course, we have to be careful because the carrier also disappears at other values, such as at a modulation index of 5.5 and 8.65.

We can see this a bit better if we graph the data from **Table 1**, as shown in **Fig. 1**. Here you can see how the carrier starts out with a magnitude of 1 when the modulation index is 0, then decreases until, at a modulation index of 2.405, it crosses the zero line and becomes negative. It then reaches a negative maximum at a modulation index of about 4, and then goes up again. It keeps oscillating, but generally gets smaller and smaller, while more and more sidebands appear at the right.

Bandwidth

The more sidebands there are, the greater the bandwidth of the signal. At a very low modulation index (below 0.5), there is only one set of sidebands, which makes the total bandwidth about the same as AM. With larger modulation indexes, the number of sidebands increases and the bandwidth goes up.

Fortunately, something else is happening which keeps the total bandwidth reasonable. Remember how we defined the modulation index:

$$MI = \frac{\text{deviation}}{\text{modulation frequency causing that deviation}}$$

To get a large modulation index, you need a large deviation but a small modulation frequency. The modulation frequency, however, determines the

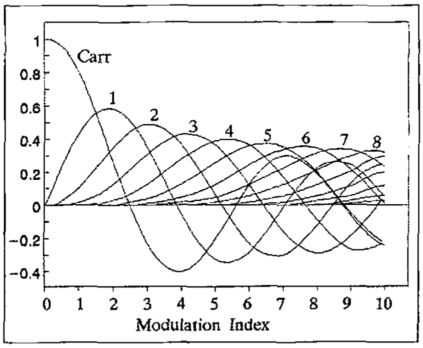

Fig. 1. FM carrier and sideband amplitudes.

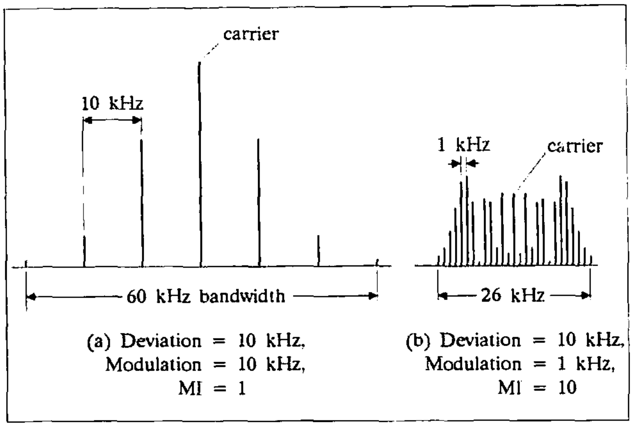

Fig. 2. FM, same deviation, different modulation index.

spacing between sidebands. So at a high modulation index, you may have many sidebands, but they will be close together, so the total occupied bandwidth will not be as large as you might think.

Fig. 2 shows an example. At left, we see the spectrum when the deviation is 10 kHz and the modulation frequency is also 10 kHz; the resulting modulation index is 1, and there are three sidebands on each side. Since they are 10 kHz apart, the total bandwidth is 60 kHz. On the right, the deviation is also 10 kHz but the modulation frequency is only 1 kHz. The modulation index is now 10 and there are 13 sidebands, but the sidebands are only 1 kHz apart, so the bandwidth is only 26 kHz.

In the real world, things are somewhat more complicated than what we've described so far. Our discussion so far has assumed that the FM transmitter is sending out pure tones—much like an announcer whistling a single note into the mike. In practice, regardless of whether we deal with voice, music, or data, the modulation signal consists of many different frequencies at the same time. The Bessel function analysis then becomes much more complicated, because the interactions between all these tones themselves produce additional sidebands.

Then too, even when the modulation is fairly simple, different frequencies exist at different voltages. In music or voice, for example, the high frequencies tend to be much weaker than the lows. Even though FM stations often boost the highs (this is called *pre-emphasis*) to overcome noise, the highs are still generally weaker than the lows, and so produce lower deviation. Commercial FM broadcast stations therefore carefully adjust their audio response to utilize their assigned spectrum as fully as possible.

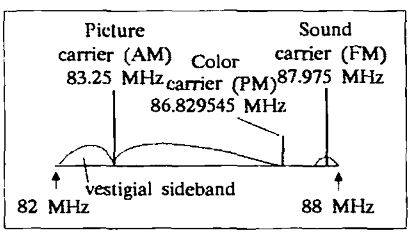

Fig. 3. TV channel 6 spectrum.

Channels

As we mentioned earlier, commercial FM stations are allowed to deviate up to ±75 kHz. Although the frequency response of their broadcast sound only extends to 15,000 Hz, they often transmit modulation up to almost 100 kHz (more on this later). The high-frequency material they may transmit up near 100 kHz is at a modulation index below 0.5 so it generates only one set of sidebands, but even this one single sideband set means their bandwidth may extend out to 100 kHz on each side of their center frequency. Hence, commercial FM broadcast stations are assigned a *channel* which is 200 kHz wide.

The U.S. FM broadcast band extends from 88 to 108 MHz; the lowest FM station on the band would be assigned a 200-kHz-wide channel from 88.0 to 88.2 MHz, with its center frequency at 88.1. The next station up could be centered at 88.3 MHz, with its channel extending from 88.2 to 88.4 MHz. This explains why all the FM stations in your area are at odd tenths of MHz: .1, .3, .5, .7, or .9 on the dial.

In practice, though, two stations in the same area cannot be assigned adjacent channels, because the bandwidth of the tuned circuits in FM radios is not narrow enough to separate two such adjacent stations. So rather than being spaced 200 kHz apart, FM stations in the same city are often 400 or even 600 kHz apart. The in-between channels are used by stations farther away.

TV channels are assigned in the same way. Each TV channel is 6 MHz wide. Starting at the low end, their frequencies are:

Channel 2: 54 to 60 MHz
Channel 3: 60 to 66 MHz
Channel 4: 66 to 72 MHz
Channel 5: 76 to 82 MHz
Channel 6: 82 to 88 MHz
Channel 7: 174 to 180 MHz, and so on.

Note several interesting things: There is no channel 1; channels are usually adjacent, but there is a 4 MHz break between channels 4 and 5; channel 6 is just under the FM band, which starts at 88 MHz; and there is a big break between the "low VHF" channels, channels 2 through 6, and the "high VHF" channels, numbered 7 through 13. The space between them contains the FM broadcast band, aircraft frequencies, the 2 meter amateur band, marine channels, and commercial two-way frequencies. The UHF channels begin at 470 MHz and extend up to 900 MHz.

In any given area, to avoid interference between them, two TV stations will never be assigned adjacent channels. In New York City, for example, there are TV stations on channels 2, 4, 5, 7, 9, 11, and 13. How can there be stations on both channels 4 and 5? Only because there is a 4-MHz-wide space between them—they are not really adjacent.

If you have cable TV, you may be wondering why there can be stations on adjacent cable channels. The reason is that most modern TV sets can (just barely!) separate two adjacent TV stations under the condition that they are both the same strength. The cable network has full control over the strength of all its channels, and can satisfy this condition. On-the-air signals, on the other hand, vary in strength depending on how far you are from the transmitter, and there can often be tremendous differences in signal strength between stations.

While we are discussing TV transmission, this might be a good place to again mention what kind of modulation is used for TV, and how the 6 MHz channel is divided up.

Fig. 3 shows a typical TV channel spectrum. We show channel 6, but all the VHF and UHF TV channels are laid out exactly the same way. Each TV channel takes exactly 6 MHz of bandwidth; channel 6 uses 82 to 88 MHz. The

picture is sent using AM vestigial sideband modulation (which was discussed at the end of Part 7), with the AM carrier exactly 1.25 MHz from the bottom frequency of the channel; in channel 6, this places it at 83.25 MHz.The sound is sent on an FM carrier, whose frequency is exactly 4.5 MHz above the picture carrier; this places it at 87.75 MHz. In fact, if you live in an area with a channel 6, and if you have an FM radio which will tune slightly below the 88 MHz end of the FM band, you can hear the channel 6 TV sound.

3.579545 MHz above the picture carrier (which is 86.829545 MHz in this case) is a third carrier, which carries the color or *chroma* information. Since this carrier is sent as part of the picture signal, it is called a *subcarrier*. This signal uses phase modulation.

Phase modulation

PM or *Phase Modulation* is so similar to frequency modulation that equipment designers often use a PM modulator to produce FM. Because of their similarity, it is difficult to clearly explain the difference between FM and PM, so read this section very carefully.

First, to make sure you fully understand FM, let's talk about a commercial FM broadcast station at 96.3 MHz. The frequency of its unmodulated FM carrier is its center frequency (96.3 MHz). When the audio signal starts, the frequency varies (deviates) from its center value. At any given instant of time, the frequency change at that instant is proportional to the audio voltage at that instant. For example, suppose the transmitter is designed to produce the full ±75 kHz deviation with an input voltage of ±7.5 volts. The signal frequency might then follow the structure of **Table 3**.

Whenever the audio voltage is +1 volt, the transmitter frequency at that instant will be 96.310 MHz. It doesn't matter how the audio voltage got there—the signal could be coming from a 1-volt DC battery, or it could be the peak of a 1-volt sine wave, or it could just be passing through the +1 volt value on its way up or down some strange-looking waveform. At any instant of time, the FM signal frequency depends only on the audio voltage at that same instant.

Another important concept to understand is that if the audio voltage remains constant for a while, then the signal frequency is also constant (though it may not be at the center frequency). When the audio signal changes, the signal frequency changes, and the faster the audio changes, the faster the signal frequency changes.

Now, let us discuss phase. Phase measurements are used to compare two or more signals to see if they are "in step" with each other, and if not, how much they differ. Let's consider a real simple-minded example, in which someone talks about a parade and says "that marcher is 180 degrees out of step with the others." What is meant is that this particular marcher is doing the exact opposite of everyone else—when everyone else steps forward on their left foot, this marcher steps with his right foot, and so on. Zero degrees phase difference means being in step; 180 degrees difference means doing the exact opposite; 90 degrees difference would mean being "halfway out of step," and so on.

Although phase measurements usually compare two or more signals with each other, we can also use them to compare one signal to itself. Let's return to that parade marcher. Suppose you see him (or her) take two steps; based on this, you can predict when the third step should come. If the marcher takes that third step a little sooner than you expected, then that step occurs earlier in phase. To do that, the steps are coming closer together, so the frequency has also increased. So phase changes go with frequency changes.

Hence, frequency modulating a signal produces phase modulation, and phase modulation produces frequency modulation. So what is the difference?

Remember the definition of modulation index:

$$MI = \frac{\text{deviation}}{\text{modulation frequency causing that deviation}}$$

The difference between FM and PM is this: Suppose an announcer steps up to the microphone and whistles a low note (for instance, 500 Hz), followed by a high note (for instance, 1000 Hz) at the same volume (imagine a sound like "boop-beep"). In both FM and PM, these two notes produce both frequency and phase modulation, but in FM the deviation for both notes would be the same (meaning that the modulation index is different), whereas in PM the modulation index is the same (meaning that the deviation is different).

In practice, things get a bit confused here, because radio stations routinely boost the treble to reduce the noise, so the deviation would change slightly even in FM, but let's ignore that little complication. So, for example, FM might produce 2000 Hz deviation for both notes; the modulation index would then be 2000/500, or 4 for the 500 Hz note, but only 2000/1000, or 2 for the 1000 Hz note.

In PM, on the other hand, the 500 Hz note might produce 1000 Hz deviation (for a modulation index of 1000/500, or 2), while the 1000 Hz note would produce 2000 Hz deviation (for a modulation index of 2000/1000, also equal to 2).

This greatly affects the bandwidth of the signal. In FM, lower frequencies produce a higher modulation index; this gives more sidebands, but they are closer together, so the total bandwidth stays pretty constant and doesn't depend on the audio frequency. In PM, on the other hand, the modulation index is independent of audio frequency, so the number of sidebands stays the same regardless of audio frequency, but with higher audio frequencies the sidebands are farther apart, so the bandwidth increases.

The bottom line is that PM is useful for communications-quality audio, whose audio content doesn't go much above 3000 Hz. It would not be good for real hi-fi audio, because the high frequencies in hi-fi audio would require too much bandwidth.

To finish up, here are two more points. First, you can generate FM with a PM transmitter, and vice versa. All you have to do is to process the audio going into the transmitter. For example, an FM transmitter produces too little deviation for high frequencies, so sending the

Audio Voltage (volts)	Frequency Change (kHz)	Signal Frequency (MHz)
+ 7.5	+ 75	96.375
+ 1.0	+ 10	96.310
0	0	96.300
- 7.5	- 75	96.225

Table 3. The signal frequency of a transmitter producing ±75 kHz deviation with ±7.5 volts input.

audio through a high-pass filter (which increases the high-frequency treble) will increase the deviation to that of a PM transmitter. Doing the opposite, cutting the treble with a low–pass filter, will make a PM transmitter send out frequency modulation. In fact, many FM transmitter designs do just that; it results in a more stable signal.

Finally, as we said earlier, things get a bit more complicated because of FM stations' efforts to reduce noise. Since most audio signals contain mostly mid-range signals and relatively little energy in the high frequencies, most commercial FM transmitters boost the treble; this process is called *pre-emphasis*. This makes the signal a bit more like PM, but it's okay because of the low amount of high frequencies to begin with. A *de-emphasis* circuit in the receiver then reduces the treble back to the normal level. In the process, the de-emphasis circuit also reduces any hiss which crept into the signal.

Conclusion

FM and PM are similar to each other, but fundamentally different from AM. All three have a carrier which is modulated in some way, and that modulation causes sidebands, but how those sidebands interact with the carrier is very different.

Because noise basically affects amplitude, you can remove it from an FM or PM signal by clipping (limiting) the signal to a fixed amplitude; this does not change the frequency or phase and so doesn't affect the modulation. However, you cannot remove this noise from an AM signal without affecting the amplitude, and therefore the modulation itself. FM and PM can therefore provide the better signal-to-noise ratio that listeners want for good music, but getting the best signal-to-noise ratio also requires a wide deviation. Hence, FM signals used for music also have fairly much wider bandwidth than most AM signals.

In those communications applications where real hi-fi sound is not required, narrow-band FM (NBFM) with fairly small deviation and a small modulation index can produce bandwidths not much larger than AM. This is the mode that is used for most mobile communications such as amateur repeaters, police and fire communications, business users, and cellular telephones. 73

Number 68 on your Feedback card

From Kilowatts To Femtowatts?

Wrestling with those dog biscuits.

Bill Parker W8DMR
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While your transmitters may be able to provide up to a kilowatt of power to the transmission line connected to the antenna, how much of that power reaches another ham's receiving antenna? And how much is needed to make the receiver work?

Typically, 50 microvolts is needed at the antenna terminals of the receiver to produce an S-9 signal. One S-unit represents a nominal 6 dB (decibel) level change.

Assuming the input resistance of the receiver is 50 ohms, how much power will 50 microvolts provide? Let's consult Dr. Ohm.

P (watts) = E^2/R.

Are we OK so far?

E = 50 μV = 50 x 10^{-6}V.

So $E^2 = (50 \times 10^{-6})^2 = 2{,}500 \times 10^{-12}$.

$P = 2{,}500 \times 10^{-12}/50 = 50 \times 10^{-12}$ watts, which is 50 picowatts, or 50 trillionths of a watt.

An S-9 signal is actually a high level. So what if the level of signal is only S-3? With an S-9 level equal to 54 dB and S-3 equal to 18 dB, it's 36 dB below S-9. A reduction of 36 dB means the signal has been lowered by a factor of 4,000 or 2^{12}. The 50 picowatts, when reduced by 6 S-units, lowers the input signal to 12.5 femtowatts. A femtowatt is 1 x 10^{-15} watt. What is the attenuation (in dB) if a kW is radiated and 10 femtowatts arrive at the DX station's receiver?

Attenuation = 10 Log (1 kW/10 femtowatts) = 10 Log (1 x 10^3 watts/10 x 10^{-15} watts) = 170 dB.

This amounts to one part in 100,000,000,000,000,000 of the original signal that started. Earth-moon-earth (EME) ham operators have attenuation paths of about 250 dB. High gain, narrowband receivers with low noise preamps are needed to work the 480,000 mile EME path.

As the signal travels in space it is also spreading, so only a very small fraction of the original kW is available to the ham located far away. The attenuation due to the signal spreading (the inverse-distance law) is called path loss. 73

BC Band Antenna Switchover Relay

A better way for Icom HF radios.

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Many of the Icom HF ham transceivers—those with general coverage shortwave reception capabilities—require physically changing the HF antenna connection on the rear apron of the transceiver to enable your ham antenna to also be used as a BC band antenna. The changeover also requires the use of an SO-239-to-RCA phono connector adapter to adapt the normal transmission line PL-259 connector to the phono jack input on the radio. This isn't very handy for most of us—there must be a better way!

Fig. 1 shows one better way. It's a totally automatic system that provides a way around this inconvenience in the Icom IC-745 transceiver specifically; however, the principle can be used in most other Icom transceivers, though the details may vary slightly from one set to another. The receive antenna path is normally looped out the rear of the transceiver to provide access for a separate receiver. This loop is broken, and controlled by a small relay that feeds it to either the RX IN or BC IN inputs. You can use the schematic diagram in **Fig. 1** as a guide for finding the correct BC band voltage pick-off point in your own particular Icom model of transceiver.

The principles

Here then are the principles: The 8 volt "BC band enable" signal is tapped off of the junction of D-14, D-15, C-154, and L-43, and routed to an unused pin (# 24) on the IC-745's rear apron "accessory" Molex connector. It's then brought into a newly-built relay box containing a 9 volt SPDT relay which will be used to switch the HF antenna into the BC band antenna input on the radio anytime the BC band is selected on the dial (and all automatically). Quite a difference in convenience, while still maintaining the isolation of the BC band from the rest of the HF shortwave band as originally intended by Icom.

The three short output coax cables from the new relay box, which are terminated in RCA "phono" type connectors, do the RF signal routing. The only addition inside the radio itself is the single DC wire to accessory connector J3, pin 24. RG-58 or the miniature RG-174 cable would be ideal, but any shielded cable works OK. The relay and its connections can be housed inside any small project box you choose, then tucked neatly away behind the radio and out of sight. The new relay box only handles receiving level signals, so a power relay isn't needed and the transmitter's signal path is completely unaltered.

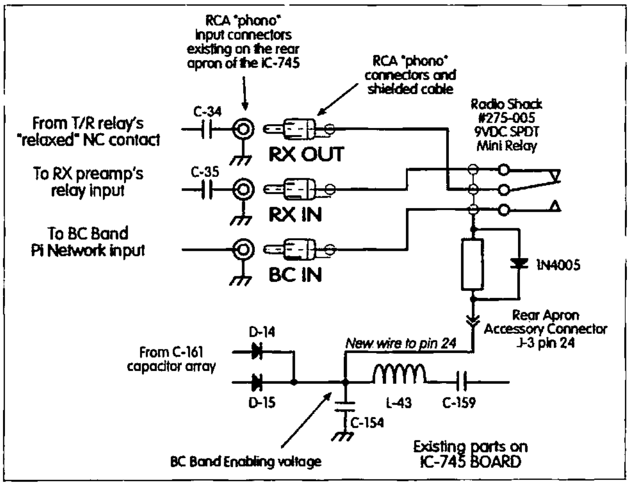

Fig. 1. Schematic diagram of the outboard switch-over relay that enables the HF antenna to be used for BC band reception in the Icom IC-745.

Finishing touch

I housed the relay and cable connections inside a 1" x 2" x 1" Sescom MPB-1* miniature aluminum project box and, in turn, mounted the box on one of the rear screws that hold the IC-745's heat-sink cover in place. Sescom's boxes are interesting because they are in "kit form," using flat aluminum sheet stock for the sides and end pieces, but held together with custom-made extruded aluminum angle at the four corners and then secured with four small Philips-head sheet metal screws on the top and bottom ends. They allow for nearly endless customization. This scheme affords a very neat, low-profile installation, and the aluminum box provides complete shielding for the relay and cable ends. The shielded cables between the box and the transceiver's inputs are literally just a few inches each so they don't affect the transceiver's performance. Once the switchover relay is installed the antenna will change input ports as soon as you go to the broadcast band. You'll never have to fumble with swapping cables on the back of your radio again!

"You'll never have to fumble with swapping cables on the back of your radio again!"

*The MPB-1 used by the author (and other boxes in the MPB series) are available from Sescom, Inc., 2100 Ward Drive, Henderson, NV 89015-4249 (1-800-634-3457 orders only or 1-702-565-3993 for information).

RTTY LOOP

Amateur Radio Teletype

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Last month I discussed some of the ways that digital information can be impressed onto a single signal. What I left out, though, is the mechanism for putting that signal over a radio wave. After all, the name of this column is "RTTY Loop," not "TTY Loop"!

Recall for a moment that the schemes we came up with last month basically involved assembling a group of on and off pulses into a sequence that would represent one letter, number, or machine function. The idea is to transmit these pulses, sequentially, on an amateur radio frequency.

Early modes

The first scheme tried, way back when radioteletype was first starting out, was called on-off keying. Very simple to understand, and conceptually the obvious first choice, on-off keying just keys the transmitter in step with the code pulses, creating what is in effect a very high speed CW signal. **Fig. 1** illustrates this technique; other figures are also grouped here for comparison. The advantages of this technique are related mainly to simplicity in transmitting: You merely hook the teleprinter to the key jack. Reception is also easy, with no need for the fancy circuits other techniques demand. The disadvantages of this simple mode relate primarily to interference susceptibility and fading. A nearby CW signal can wipe out an on-off TTY station, and fading can remove whole letters.

A better way to send RTTY is by presenting a constant signal for the MARK state, changing it in some way to represent the TTY signal. Changes may be introduced in amplitude, frequency, or by a superimposed modulating waveform. Direct amplitude modulation with the digital signal approximates on-off keying, with its attendant flaws.

FSK and AFSK

Over the years, a frequency modulation technique has arisen as the most-used amateur mode, either with frequency modulation of the RF carrier frequency, FSK (or frequency shift keying), or with frequency modulation of a superimposed audio signal, AFSK (or audio frequency shift keying).

In FSK, a carrier is shifted in frequency to correspond to MARK and SPACE. **Fig. 2** diagrams this nicely. This system, as are all to follow, is a redundant system. That is, information is obtainable by looking at either MARK or SPACE, even in the absence of either one. Remember that in on-off keying, if you lose the SPACE you have a steady MARK, and if you lose the MARK you have nothing. Transmission of FSK is accomplished by shifting the transmitter VFO in step with the digital signal, and reception by decoding either or both the MARK and SPACE. Done properly, this system is virtually immune to interference and, since fading normally affects only one of the MARK or SPACE frequencies at a time, proper use of the built-in redundance makes fading no problem either. The frequency shift involved may be anything from kilohertz to fractions of a hertz, which might be more properly called "phase shift." In amateur circles the original standard, before modern equipment, computers, and band cram, was 850 Hz; nowadays, most FSK signals are shifted only 170 Hz.

"The Radio Data Code Manual *includes just about every teleprinter communications scheme that exists, explained and diagrammed.*"

Unfortunately, FSK presumes very stable transmitters and receivers. The level of shift is certainly less than one kilohertz, and drift in either the transmitter or receiver of any significant degree would be intolerable. VHF transmitters, especially early ones, would not maintain this degree of stability. Use of an audio tone, shifted in frequency in a manner similar to FSK, became the standard on VHF links. This AFSK is more useful than it appears at first glance. Realize that transmitting tones over radio is not that different from transmitting tones over telephone wires, and this scheme forms the basis of all those computer modems, networks, and the World Wide Web.

Other techniques

Now, how about some alternative schemes? Two such techniques employed along the way used brief pulses to encode data, rather than longer segments. For example, with a "standard" 60-word-per-minute radioteletype signal, each data pulse is 22 msec long. What if a brief pulse was sent during each 22-msec window, with either its amplitude or position within the window representing the pulse's state? The resultant Pulse Amplitude Modulation (PAM), or Pulse Position Modulation (PPM), is shown in **Fig. 4**.

Having to transmit pulses sequentially imposes a limit on just how fast you can transmit, given that you can only divide a cycle so many ways.

The solution to that is to assign groups of pulse patterns to different frequencies. Thus, transmitting a sequence of frequency blips may encode quite a few more data bits. For example, rather than have one frequency for MARK and one for SPACE, suppose you had one frequency, say 500 Hz, for the bit pair "00," 1000 Hz for "01," 1500 Hz for "10," and 2000 Hz for "11." You could then send the "RY" sequence, 01010=R and 10101=Y, as 1011011011011011 in five pulses rather than 10. With each pulse taking the same time, you can double the speed. It is not hard to see that by making this a tad more complex, by making each data word longer and assigning more tone steps, speed could be increased even further. Not only that, but by employing data compression, an instruction could lump that sequence of five 1011 data words into a control word which says repeat times five, and the data word only once. This is, basically, how many forms of data compression work, including those involving data transmission.

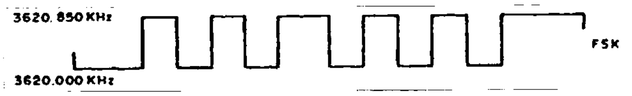

Fig. 2. In FSK, a carrier is shifted in frequency to correspond to MARK and SPACE.

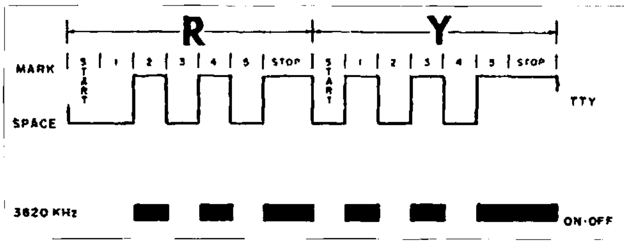

Fig. 1. On-off keying.

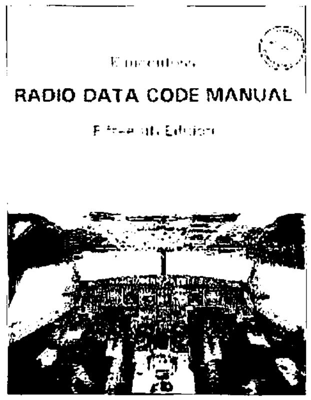

***Photo A.** The* Radio Data Code Manual *is available for DM70 from Klingenfuss Publications.*

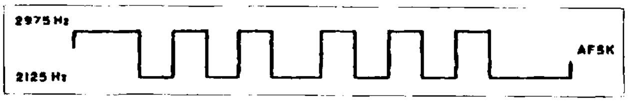

Fig. 3. AFSK, audio frequency shift keying.

All of these schemes have concerned themselves with only one end of the data transmission scheme. But transmission implies reception, and there are quite a few techniques for enhancing data interchange as well, other than the simple "I talk, then listen to you" model. This is where we get to packet, AMTOR, and the like, but this is also for a future discussion.

New reference book

Reference books have long been lacking in this area, but a new one has been published which includes just about everything the digital amateur could want in the way of such information. Our old friend, Joerg Klingenfuss, who has been writing authoritative tomes for about 30 years now, has published his 15th edition of the *Radio Data Code Manual*. It includes a raft of meteorological codes with detailed examples, over 10,000 meteorological stations indexed, aeronautical telecommunications abbreviations, company and aircraft designators, CW and RTTY alphabets for Arabic, Chinese, Cyrillic, Greek, Hebrew, Japanese, and other non-Latin alphabets, and just about every teleprinter communications scheme that exists, explained and diagrammed.

Photo A. shows the cover of this 600-page publication, which is available for DM70 from Klingenfuss Publications. Check out Jeorg's stuff on his home page at: http://ourworld.compuserve.com/homepages/Klingenfuss/ or drop him a letter at Klingenfuss Publications, Hagenloher Str. 14, D-72070 Tuebingen, Germany.

Stop by the RTTY Loop home page as well, at: http://www2.ari.net/ajr/rtty/ for columns, features, and other items of interest to digital amateurs. The full listing for the RTTY Software collection is online there, but it is also available by sending a self-addressed, stamped envelope to the address at the head of this column, for those of you who are not yet online or who cannot download from the Web. I look forward to your comments and questions, as always, at ajr@ari.net, Marc WA3AJR@aol.com, or 75036.2501@compuserve.com.

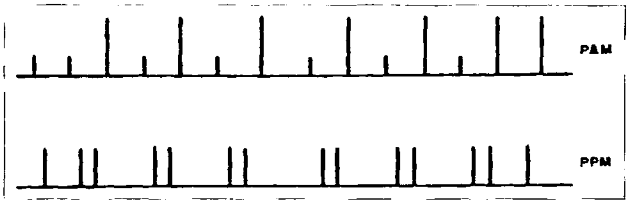

Fig. 4 . Pulse Amplitude Modulation (PAM), or Pulse Position Modulation (PPM).

NEVER SAY DIE

Continued from page 60

personal computer revolution almost entirely.

Bill Gates and Steve Jobs, the two most successful personal computer pioneers, were both college-dropout entrepreneurs. They're both billionaires now, thanks to the blindness (aka stupidity) of the computer industry professionals.

Today this whole scene is being replayed in the world of physics and power. Will the future titans of power be today's cold fusion pioneers? It's most likely, given the refusal of universities and power industry firms to recognize this new technology's potential. It's the same blindness that killed Centronics, which was the largest manufacturer of printers in the world—for minicomputers. Microcomputers blew them away.

When we're able to generate power at a tenth the cost of fossil fuels such as coal, oil, and natural gas, there will be no power bloc strong enough to stamp this out.

The fuel and power companies are working on the basis of "to hell with tomorrow, let's make all we can right now." So

Continued on page 76

Number 72 on your Feedback card

Above & Beyond

VHF and Above Operation

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2304 MHz—A Club Project

Members of the San Diego Microwave Group have embarked upon an ambitious construction program, aimed at increasing our amateur ranks with operational transceivers for the 2, 3, and 5 GHz amateur bands. Our intent was to put together the simplest basic transceiver for use at our monthly group meetings. Kerry N6IZW's intent was to construct a transceiver each month for the 2, 3, and 5.6 GHz bands. Sounds like a very ambitious construction project; however, the driving force was to make some of these rigs usable in the June VHF/UHF contest.

This project was not intended to be a backbreaker, but rather an interesting construction project in our lower microwave bands. Nothing was set in stone as a rigid design; the only requirement was that the rig should be capable of operation with either narrowband FM or SSB. This meant that the basic design has to be, at minimum, a local oscillator, a mixer, and an antenna. The most critical part of any system is the local oscillator, as its stability must be sufficient to support operation on narrowband FM as well as single-sideband.

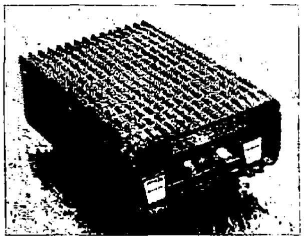

Photo A. Basic cabinet structure (old-style) from Qualcomm. Front panel contains DC power connector, input IF/output RF coax connectors. Toggle switch used for manual RX/TX transfer control.

The 10 GHz band that microwave equipment can be obtained for is just what this column is all about: different material being used to construct transceivers from scrounged material obtained from surplus, in addition to using the Qualcomm 3036 PLL synthesizer chip. This chip and the surplus PC boards our group has available have given us the ability to provide for frequency generation for these converters easily and inexpensively. It is fitting that the local oscillator (LO) is the basic building block of all converters. The main premise here is that if you can find an LO for use in a converter at one or several of our microwave bands, the other parts for construction of a transverter are not far behind.

Our new project

The first rig to be constructed will be for 2304 MHz; the month following, it will be a rig for 3456 MHz; and the month after that, a rig for 5760 MHz. What shows up and who constructs a rig for which frequency has been left up to the individuals wishing to participate. I am sure those who participate will not produce a rig for each of the frequencies as this is quite ambitious, but I am also sure that there will be quite a few different rigs to make things interesting, just to see what shows up for testing in preparation for the June VHF/UHF contests.

The prime ingredients in any project are initiative and direction, and we seem to be blessed with lots of those qualities within our group. Pete W6DXJ had the head start on this frequency as his station was partly assembled prior to the beginning of our building program. Pete had been prodding us to get on 2304 as well as 1296 MHz, but when we announced the fast-paced drive to construct a 2304 MHz rig for next month, he scrambled just as fast as all of us to finish a 2304 MHz transceiver.

Well, the next month came and several 2 GHz rigs were constructed. Pete W6DXJ brought his station, as did Kerry and I. This gathering, at Kerry's home, proved to be quite enjoyable. We made many contacts using both wideband FM and SSB operation. One funny aspect was that we all had selected the same IF frequency on 2 meters (144.1 MHz using a 2160 MHz local-oscillator frequency).

When we fired up the transceivers, we found that all stations being co-located produced very good contacts on 2 meter feedthrough. This produced quite a confusion factor at first, until we separated the 2 meter bleed-through from the 2304 MHz actual RF. We directionalized the test antennas at each other and when we obstructed the direct antenna's path we would get a 5 to 6 S-unit decrease in signal strength. We covered the antenna up with our hands on the receiving end of the path for this test. All stations were located inside the garage or out on the patio for initial tests.

On the next cut of operation, Kerry and I tested a path of some four miles, with an excess margin of 60 dB in signal on this short path. We were using about 25 mW transmit power and a 30-inch dish for this test. While this was a peanut-whistle, it was still a working station.

Construction techniques

First, let's describe Pete W6DXJ's station. This station was started as a kit from Microwave Modules, one of their series of no-tune transverter kits for 2304 MHz. Pete had modified the original PC board circuitry; he removed the crystal oscillator multiplier circuits and replaced them with a microwave synthesizer that our group makes available. This modification was done to provide increased frequency stability for the local oscillator, making exact frequency setting at 2304 MHz a reality.

Now, there is nothing wrong with a crystal oscillator that operates near 100 MHz and its associated multiplier circuits used to increase its frequency to the microwave range. The problem is that the crystal has a frequency stability problem you should be aware of. As with any circuit,

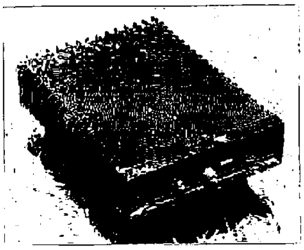

Photo B. New-style cabinet that is shorter in height than old-style cabinet. Cabinet provides a hardened interior for protection of microwave circuitry, and provides an RF tight-enclosure.

there are liabilities and attributes. On the crystal's side of things, it produces a very clean local oscillator signal (low-phase noise products). However, its frequency accuracy (stability) is of concern. Its error increases with frequency multiplication as it is subject to the effects of temperature and voltage shifts.

The solution that our San Diego Microwave Group chose was to replace the crystal circuitry with one of our Qualcomm surplus synthesizers, because we had the material and wanted to make use of it (the prime directive: locating inexpensive materials). The synthesizer was frequency-agile, so we reprogrammed it to provide 2160 MHz directly from a VCO-controlled oscillator co-located on the Qualcomm synthesizer PC board. It maintains high accuracy because it is driven by a 10 MHz reference oscillator which is accurate to 1 hertz in 10 MHz, providing accuracy at 2160 MHz to within a few hundred hertz.

This synthesizer output is about +10 dBm and is a direct connection to the mixer. However, all is not perfect here, as you must realize. While the synthesizer is quite frequency-agile, it does have some noise products. Phase noise is degraded in comparison to a crystal oscillator. With a synthesizer, phase noise is something you have to live with, compared to a crystal operating at 100 MHz and multiplied to the 10 GHz band (a test point for evaluation of the crystal and synthesizer). The crystal oscillator produces a spectral-clean local oscillator signal (at 10 GHz) with phase noise products down about 70 dB or

more. Comparing this to the synthesizer when multiplied to 10 GHz (an equal playing field for measurements), we measured phase noise products 35 dB down.

Now, you say this is worse than the crystal oscillator. Well, yes it is, but consider the simplicity and ease of converting a system that has excellent frequency stability. The synthesizer has a frequency variance at 10 GHz of less than *several hundred hertz!* When used at lower frequencies, such as 2304 or 3456 MHz, it is quite superior to most anything else. (Yes, I make these surplus synthesizers available. When you have something that is relatively inexpensive and operates very well you can't stop beating its drum. These synthesizers can be converted from their original state to a new frequency much more easily and with minimal test equipment and cost, than other methods such as crystal oscillators and associated multiplier strings.)

Crystal vs. synthesizer

There has been much discussion about the merits of crystal oscillator vs. synthesizer-controlled oscillators, and many debates about each method's merits and problems. However, at the amateur level there are no "deep pockets." For me, the bottom line is that when a crystal can be made as accurate and inexpensive as the synthesizer, then I will move over to the crystal. If you have the crystal and it is the only oscillator you have, don't get me wrong—*use it.*

The synthesizer is a very good oscillator and works well when we forget about the mystical properties it is supposed to have. I hope I have helped to show that it can be used with relative ease by modifying commercial material for microwave frequency generation. The prime benefit is very high frequency stability, comparable to VHF radio operation. Having this stability in a system removes one more obstacle, making that rare or interesting contact easier.

Once you have tried high stability operation, you will not miss the hit-or-miss operation of tuning for contacts. It can be done, but take my word for this; when you say, "I'll meet you on 2304.100 MHz," I know I am there. When the other station so equipped transmits, I only have to adjust the clarifier to make contact. If only one station in your area operates with frequency synthesis, then certainly that station can be used to set others on frequency, removing that element from preventing you from making contacts. Your enjoyment will increase when frequency disparities can be reduced or eliminated. My recommendation is: don't rotate the dial up and down the band searching for a 2-kHz-wide signal in the vast megahertz bands.

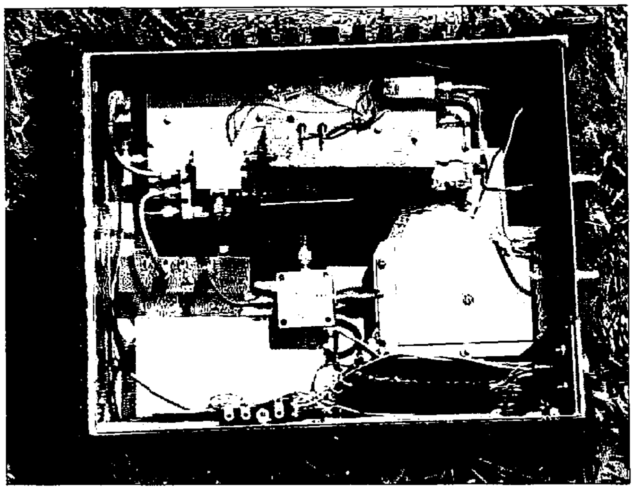

***Photo C.** Interior of 2304 MHz converter. The Qualcomm 3036 synthesizer is at bottom right in the metal container; the 10 MHz crystal is wrapped in black rubber for shock resistance. The amplifiers required -24 volts, so I used an LT-1070 switcher to convert from +12 volt to -24 volts. Top: receive and transmit amplifiers, mixer in the middle.*

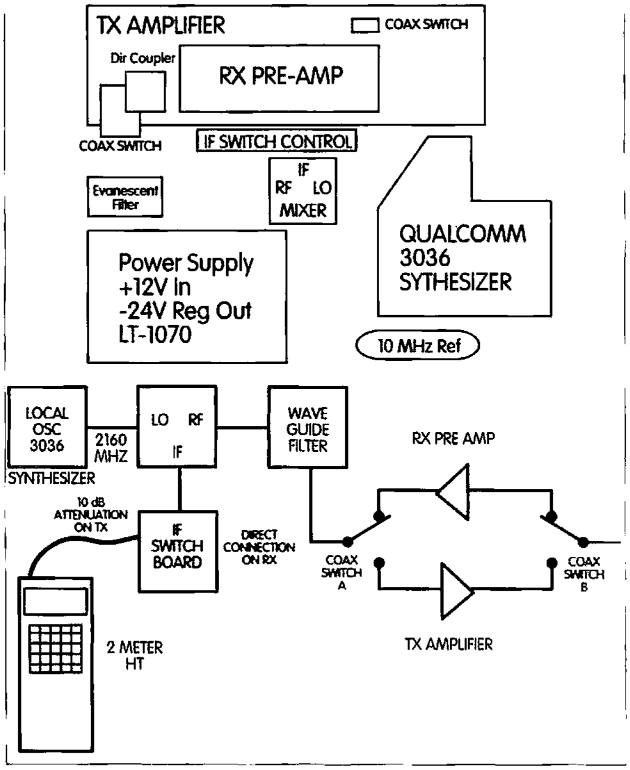

Fig. 1.** Block diagram and parts placement diagram of the 2304 MHz converter shown in **Photo C.

Don't shoot down the vast frequency available on the microwave bands; these lend the amateur operator the ability to explore many new and different modes of communications. There has been much interest generated in the new computer innovations for packet operation using very high-speed modems with very large bandwidths. This type of system, as well as experimentation in video transmission, require megahertz-frequency bandwidths for test and development by amateurs using amateur microwave frequencies. That is one of the reasons that we have attempted to push forward construction on these bands. My construction project might be part of the development of other modes of operation yet to be envisioned.

The ability to do this work on the amateur bands has enabled a free-thinking flow of new experimentation in electronics, for pure research and for developing untried concepts at the amateur level. I can't describe an exact product that has been developed in this manner. However, when ideas can take on this amateur electronics type of development, train and apply them to tests and implementation; new technology may be the result. Amateur radio is not just a hobby to a lot of amateurs employed in the electronics industry today. To many of us, it has become an outlet for personal satisfaction and enjoyment—pursuing new and interesting techniques. It is to these innovators that we owe much, and they provide a source for new and interesting material.

These are some of the benefits and problems associated with these different types of oscillators, like the synthesizer and the crystal-multiplied oscillator. Take a look at the concerns and decide for yourself. The bottom line on what to recommend is what you are able to locate and use inexpensively to construct your system. That's the real choice for the pure enjoyment of the task. That is what surplus is all about to the radio amateur: inexpensive alternatives to solving a circuit problem.

So much for innovation. Let's get back to the local oscillator and the rigs that were constructed.

W6DXJ's project

Pete W6DXJ had a long loop yagi antenna for use at 2304 MHz that coupled to his transverter, purchased from Microwave Modules. Pete made a few modifications to the Microwave Modules transverter's basic circuit. He included a low-pass filter consisting of an RFC and a 20 pF capacitor in the 144 MHz IF circuitry. He did not build the crystal multiplier oscillator string; he used one of the Qualcomm synthesizers instead. Luckily, the output frequency from the crystal string was a frequency that the synthesizer could generate: 2160 MHz.

The remainder of Pete's rig was original microwave modules circuitry. Pete commented that the synthesizer approach was quite easy, but he had plans for a much more personal pursuit for excellence in construction of a crystal oscillator string, providing external phase-locking of the crystal to a high-stability 10 MHz crystal reference. This more expensive approach would yield a great low phase noise oscillator and a frequency-accurate unit.

What Pete intends to construct is a phase-locked loop that will maintain the main oscillator crystal at a precise frequency, eliminating the frequency uncertainty of home-constructed oscillators. It is to be phase-locked to a submultiple of 10 MHz. Kerry and I developed the circuit many years ago to lock Frequency West "Brick"-type oscillators. This is too much to go into this month, so I will cover the synthesizer and the phase-locked circuits next month, along with the 3456 MHz rigs.

Antenna switching was done with only one coaxial relay as the microwave module system used separate receiver and transmitter amplifier strings. Power supply requirements were easier in this system as almost all of the power could come from a single 12-volt DC-regulated unit.

The rigs that Kerry and I constructed were almost identical, mainly because we found two sets of commercial junk to use in our transceivers. An old Collins radio for 2.3 GHz provided us with both receiver preamplifiers and a 100 mW transmit amplifier. The remaining local oscillator and other circuits had to be constructed from scratch or modified from Qualcomm surplus material. We used surplus Qualcomm aluminum cabinets to contain our microwave circuitry. These cases are heavy heat-sinked, ripple-finished, and quite attractive. They afford a nearly bulletproof transportable case for field use of our microwave equipment.

The synthesizer we used was reprogrammed for 2160 MHz, driving a double-balanced mixer. The output of the mixer was fitted with a evanescent (waveguide below cutoff) filter that is reasonably sharp and easy to construct with simple tools.

Next month I will cover the detailed information on the evanescent filter and provide detailed information on converting the Qualcomm synthesizer for amateur radio use. Best, 73 Chuck WB6IGP; clhough@aol.com.

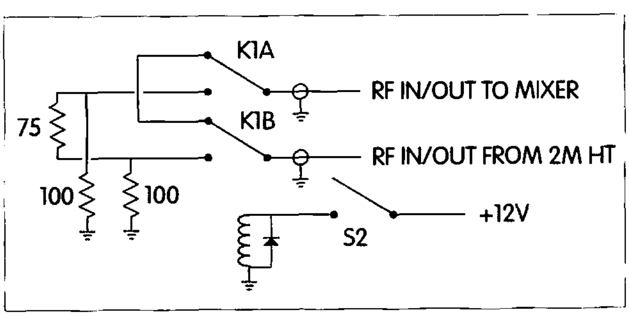

Fig. 2. Simplest IF switch for 144 MHz transfer of RX/TX IF switching. Operation uses toggle-switch actuated coaxial relay. Adjust value for transmitter attenuation. I used a 10 dB attenuator (two each 110-ohm resistors, shunted by 75 ohms); other values are possible (20 dB equals two each 68-ohm resistors, shunted by 270 ohms). Use carbon composition for RF use; 1/2 watt suitable for low power transceivers (less than 1 watt power output).

NEVER SAY DIE

Continued from page 71

how long will the coal last? Fifty-seven percent of our electric power in the US is generated by burning coal, and they're using over one *billion* tons of coal a year. A couple generations or so down the line our descendants will have to make do with a world stripped of coal, oil, and natural gas, just as most of the world has already been stripped of old-growth forests. It's interesting to fly over the Northwest's forests and see thousands of acres of what recently were forests, with every single tree cut down! Clear cutting. I'm thinking more and more as an ecologist, though I haven't been converted into a fanatic. But we sure do need to get cold fusion power generators researched and developed.

So, are you going to be one of the people who reads about what happens or are you going to be one who helps make things happen? Remember, just about every major breakthrough in science has been made by amateurs. Not all of the personal computer pioneers got to be billionaires, some just made millions. Oh, well, there are always winners and losers.

I urged my *73* readers to get into microcomputers 20 years ago and hundreds have thanked me for helping them to break loose from their jobs to start their own companies. I don't think there's ever a hamfest where one or two hams don't thank me for kicking them in the pants. Well, I'm still after you to do better ... for yourself, your kids, our country, and the world. I want you and your family to be healthy and prosperous. So I'm reading every book I can find that I think may help you toward wisdom and a longer life. And I'm finding some amazing books.

How difficult and expensive is it to be a cold fusion pioneer? The leader in America today is Dennis Cravens, a science teacher from a small Texas community college who put together a lab in his garage. His total investment was under $5,000! He's recently moved to New Mexico and is helping Jim Patterson develop his Patterson Patented Cell. Jim is an inventor and he's my age. Dennis is in his 30s.

A Waist Is a Terrible Thing to Mind

A somewhat sobering statistic emerged from my TV. I was tuned to a PBS health show and it was pointed out that of the few people who manage to live to 85, over 80% are seriously impaired. Is that what you want to look forward to? If you are one of the few to make it to 85? Most people drop dead of heart attacks and cancer long before that. Heck, I'm already to the age where half of my contemporaries are already dead.

The comforting thought is that hardly any fat people live that long, so if you've got a big gut you at least won't have to worry about being seriously impaired in your later years, because there aren't going to be any later years. Having been fat most of my life, I know all about the see-saw of diets that about 2% of fatties manage to overcome. I've been there and done that. Done it endlessly.

I know how delicious ice cream is. I know all about Danish and juicy hamburgers. But I also know I'm having enough fun irritating the heck out of you to stick around a while and keep in touch with my fat friends via my Ouija board instead of 75 or 20m. I know about the poisons which can knock down my immune system and allow cancer and other miseries to take over. Anyway, as I've mentioned before, a little over 20 years ago I finally decided that enough was enough. I went on a 1,500 calorie diet and stuck to it through thin and thin, dropping about two pounds a week until I'd lost 85 pounds. And, by changing my eating habits, I've kept it off.

Can the Bioelectrifier reset your appestat, causing your body to shed all that lard, as Bob Beck claims? I haven't heard of anyone else doing it yet, but it's still too early. Most of the research with it has been toward eliminating viruses, microbes, parasites, yeasts, and fungi in the blood. I am hearing from fairly healthy people who've experimented with the gadget and have achieved an even higher level of health. I hope that more doctors will try to overcome their indoctrination by the pharmaceutical industry and help research the potential for this approach.

If you want to learn more about what's going on, check out

Continued on page 77

ATV

Number 76 on your Feedback card

Ham Television

Bill Brown WB8ELK
139 Angela Dr. Apt. B
Madison AL 35738

Record DX on 10 GHz

Although most ATV activity in the US exists on the 70 cm and 23 cm bands (some groups also utilize the 900 MHz band), it's rare to find much going on in the higher frequencies.

One of the best-kept secrets up here is the 10 GHz region. It's one of the final frontiers for ATV, a place where most equipment must be home-brewed. Fortunately, this is one of the easier bands to build equipment for, due to the availability of surplus Gunnplexers™ and satellite TV receivers. The 10 GHz band seems to be used mostly for short-haul dedicated links for repeater systems and special events,

but there are a few dedicated folks who enjoy pushing this band to the limit. Many ATVers are deterred by the misconception that the distances that can be covered fall far short of what you can do on 70 cm. This may be true with low-power systems (the typical Gunnplexer™ system runs less than 100 milliwatts), but when you factor in tropospheric ducting, higher power, good antennas, and the ability to aim your antenna precisely, you can achieve remarkable DX on this band.

Go the distance

On May 18th, F1JSR set up his 10 GHz system on the island of Corsica in the Serra di Pigno (grid square JN42RQ) at a height of 960 meters (3148 feet). His ATV system consisted of a DRO synthesized transmitter on 10.450 GHz fed into a TWT (Traveling Wave Tube) amplifier, which delivered 20 watts to a 40 cm diameter (15.7 inches) Ikea parabolic dish. For receive, he had an off-set feed antenna of 85 cm diameter (33.5 inches), a non-modified Astra LNB, a +500 MHz converter which fed into a standard TVRO satellite receiver, in parallel with a voice receiver, to help aim the dish.

From his vantage point at Sierra de Montseny near Barcelona, Spain (grid square JN11ET and an altitude of 1650 meters, 5412 feet), Michel Vonlanthen HB9AFO set up his ATV system. He had a DRO transmitter on 10.480 GHz driving a 1 watt solid-state power amplifier, which fed a 40 cm (15.7 inches) diameter parabolic dish. His receive setup consisted of a 1 meter (39.38 inches) diameter dish with a high precision az/el gear system to point his antenna accurately.

Photo A. *Michel Vonlanthen HB9AFO successfully completes a two-way 10 GHz ATV QSO of 592 km (368 miles) with F1JSR on the island of Corsica on 10 GHz ATV, from his vantage point near Barcelona, Spain.*

Photo B. *F1JSR sets up his station on the island of Corsica.*

This fed into a modified Astra LNB with a noise factor of 0.7 dB and a modified AR3000 receiver followed by a narrowband ATV FM demodulator, in parallel with a normal TVRO satellite receiver.

The distance between these two stations was 592 kilometers (368 miles). The 10 GHz FM ATV contact was two-way, with the signals varying between P0 and P5 with color. Quick signal fluctuations were observed during the contact, probably due to the strong wind, fog, and intermittent rain in Corsica. Two days earlier, a similar QSO was successful over a 574 kilometer path (357 miles) between F1JSR (at the same location on the island of Corsica) and HB9AFO from a different location on Pic de Nore, in the Department of Tarn in France (JN13FJ). This contact lasted more than two hours. Both contacts were made around sunset.

"You can achieve remarkable DX on this band."

More details will be published in the French and Swiss ATV publications *B5+* (ANTA) and in *Swiss ATV News*. A VHS video cassette will be available soon showing this QSO. If you would like a copy, write: Swiss ATV, P.O. Box 301, 1024 Ecublens, Switzerland. *Thanks to Michel Vonlanthen HB9AFO for the above information and the photos.*

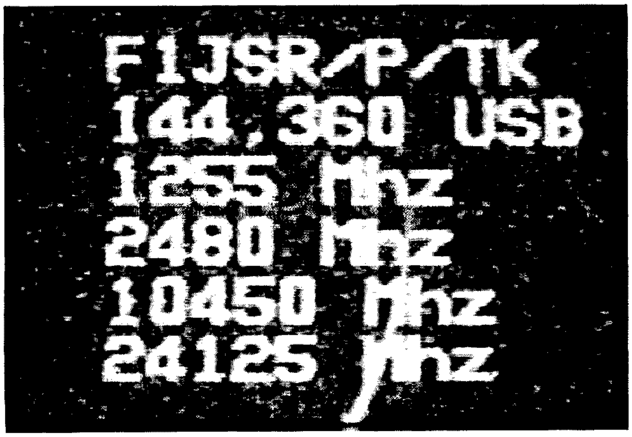

Photo C. After traveling 592 km (368 miles), this is the reception of F1JSR/P/TK's 10 GHz ATV picture as received by EA3/HB9AFO/P. in the Sierra de Montseny, Spain.

NEVER SAY DIE

Continued from page 76

the latest $10 AIDS booklet from Radio Bookshop and invest $10 more for a copy of Bob Beck's talk at the 1996 Global Science Congress. It's a lulu. He lost 85 pounds without dieting, and also regrew a full head of hair. And he was there as living proof. No more fat, bald old Bob. It took years off his age.

It's your choice: an early death via fat, a lingering death via poisons, or vibrant health when you're thumbing your nose at the Social Security people. But this is a choice you have to make now, not after you're in the hospital with cancer, a heart attack, stroke, or tied to a rocking chair in a nursing home as a gibbering veggie.

Cancer

A high percentage of us are going to die of cancer, but how much do you really know about it? For instance, are you aware that despite the 25-year multibillion-dollar war on cancer we've waged, that "medical science" has not extended the life of cancer patients one day? In fact, prostate cancer patients have a longer probable life if they are not treated than if they are. Without treatment you can expect to live around 15 years. With treatment you'll probably live less than five years.

There are several alternative approaches which have been successful in curing cancer, but since they don't involve pills or shots, there is no way for the pharmaceutical industry to make money with them, so they have not been investigated. Plus there's no group to put up the $250 million it now takes to get a new medication or procedure approved by the FDA … a 10–15-year process which keeps thousands of government employees from getting more productive work.

How about it—will I be shaking your hand at Tampa in November?

Lawyers, Lawyers!

Our media compatriots will no doubt try to make a big deal over our lawyer's decision to

Continued on page 79

Number 78 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the December issue, we should receive it by September 30. Provide a clear, concise summary of the essential details about your Special Event.

AUG 25

WOODSTOCK, IL The Tri-County Radio Group, Inc. will hold its Hamfest and Computer Show at the McHenry County Fairgrounds located just north of Rte. 14 on Rte. 47, beginning at 6:30 AM for the Flea Market and 8 AM for the exhibitors. Setup available on Sat. by appointment, or at 6:30 AM on Sun. Talk-in on 146.52 simplex. Reservation deadline is Aug. 11th. For more info, or reservations, write to *T.C.R.G., P.O. Box 3107, Skokie IL 60077-6107;* or call *Robert N9KXG, (847) 658-1678.*

AUG 31

ALAMOGORDO, NM The Alamogordo ARC will hold their 12th annual Hamfest at Otero County Fairgrounds, on White Sands Blvd., 8 AM–4 PM. ARRL Forum, MARS Forum, Flea Market, VE Exams, Banquet. Talk-in on 146.80(-). For tables and info, call *Larry Moore WA5UNO, (505) 434-0145;* or *Jim Patton N7IOM, (505) 439-8349.*

SEP 7

ERIE, PA The Erie Hamfest '96 will be sponsored by the Radio Assn. of Erie, 8 AM–2 PM, at Franklin Twp. Fire Hall. VE Exams will be held at 9 AM at Franklin Center Methodist Church (1 mi. north of the Hamfest on Rt. 98). Flea Market: vendor setup Fri. eve. 6 PM–midnight, and Sat., 6:30 AM. For reservations and info, contact *Chris Robson KB3A, 5560 Bear Creek Rd., Fairview PA 16415. Tel. (814) 474-1211; E-mail: crobson @ moose.erie.net.* Talk-in on 146.61(-) (W3GV).

UNIONTOWN, PA The Uniontown ARC will hold its 47th annual Gabfest at the club grounds located on Old Pittsburgh Rd., beginning at 8 AM. Free tailgate space with reg. Talk-in on 147.045(+) and 147.255(+). Contact *Carl WA3HQK* or *Joyce KA3CUT Chuprinko, Rt. 6 Box 231-CC, Morgantown WV 26505. Tel. (304) 594-3779.*

SEP 8

DARTMOUTH, MA The Southeastern Mass. ARA, Inc., will hold their 20th annual Flea Market 9 AM–3 PM on their clubhouse grounds at 54 Donald St., behind the Stackhouse St. Fairgrounds. Setup begins at 7 AM. Talk-in on 147.00 Rptr. Contact *Bill Miller, (508) 996-2969.*

DUBUQUE, IA The Great River ARC, Iowa Antique RC and Historical Society, and the Tri-State Computer Users Group will sponsor a Hamfest/Radiofest/Computer Expo 8 AM–2 PM at the Dubuque County Fairgrounds on Old Highway Rd., west of Dubuque. Dealer, Flea Market, Tailgating and VE Exams at 10 AM. Talk-in on 147.84/.24. Contact *Loren Heber NØYHZ, (319) 556-5755; Jerry Lange KBØVIK, (319) 556-3050;* or *Jerry Ehlers NØNLU, (319) 583-1016.* Write to *G.R.A.R.C., P.O. Box 546, Dubuque IA 52004-0546.*

SEP 13–15

PEORIA, IL The ARRL Nat'l. Convention at SuperFest '96 will be held at the Peoria Civic Center. It will showcase the latest innovations and technologies available to amateur radio operators. There will be forums and seminars on topics ranging from "Improvements for Club Operation" to "Exploring the Internet & the World Wide Web" to "Satellites & Antennas for HAMS." Exhibitors contact *R&B Productions, (309) 693-9667.* For general info, call *Ron Morgan KB9NW, General Chairman, (309) 692-3378. E-mail: SuperFest @ AOL.com.*

SEP 14

PRAIRIEVILLE, LA The Ascension ARC will hold its annual "Gonzales Hamfest" at the Gourmet Catering Inc. bldg. on Hwy. 73. Setup at 7 AM; general admission at 8 AM. VE Exams, Fox Hunt. Dealer and swap tables available. Contact *AARC, c/o Shane Dugas KK5LC. 37150 Swamp Rd., Prairieville LA 70769. Tel. (504) 673-8369.*

SEP 14–15

MELBOURNE, FL The Platinum Coast ARS will host their 31st annual Melbourne Hamfest in the Melbourne Auditorium, 625 E. Hibiscus Blvd., 8 AM–5 PM Sat., and 9 AM–4 PM Sun. Talk-in on 146.25/.85 Rptr. For info on tickets/tables, contact *Larry Sexton KF4EJB, 7005 Dogwood Dr., Cocoa FL 32927. Tel. (407) 636-8826;* or *Al Hudson N4PTM at E-mail ahudson@iu.net.*

SEP 15

HAMILTON TWP., NJ FallFest '96 will be held by the Delaware Valley Radio Assn. at Tall Cedars of Lebanon picnic grove on Sawmill Rd. Open to sellers at 7 AM, buyers at 8 AM. Talk-in on 146.670(-) Rptr. For more info, call *(609) 882-2240.* No advance reg.

MT. CLEMENS, MI The L'Anse Creuse ARC will host their 24th annual Swap and Shop, 8 AM–2 PM, at L'Anse Creuse H.S. in Mt. Clemens. VE Exams at 11 AM; contact Don WA8IZV, (810) 294-1567, Prodigy ID SSTG41a. New and used amateur radio equip., electronic parts and equip., computer and software. Trunk sales. Sep. 7 is the deadline for advance prepaid reg. Talk-in on 147.08(+) and 146.52 simplex. Make checks payable to *L'Anse Creuse ARC,* and mail with SASE to *Ralph Irish WA8GDT, P.O. Box 180122, Utica MI 48318-0122.* For more details call *(810) 731-6760 or (810) 651-7387.*

NEWTOWN, CT The Western CT Hamfest will be held 9 AM–2 PM at the Edmond Town Hall, RT 6 (Exit 10 on I-84). Setup at 7 AM. Talk-in on 147.12/.72. New Equip. Dealers, Flea Market, Tailgating, Computers. Contact *John Ahle N2DVX, P.O. Box 3441, Danbury CT.06813-3441. Tel. (203) 438-6782.*

SEP 21

LEXINGTON, NE An Amateur Radio and Antique Radio Consignment Auction will be sponsored by the Heartland ARA and the Mid-Nebraska Antique Radio Club, at Knights of Columbus Hall, 6th and Taft St. Doors open at 8 AM; auction begins at 11:30 AM. Talk-in on 147.135(+). Contact *Hoppy W4YDN, (308) 987-2161; E-mail: rh84859@ltec.net;* or *Randy WBØSAO, (308) 987-2312.*

SANTA ROSA, CA The Sonoma County Radio Amateurs, Inc. will hold their annual Swapmeet, Auction and VE Exams at the Holy Ghost Hall, one mi. north of Sebastopol CA, at the corner of Hwy. 116 and Mill Station Roads. Setup at 6:30 AM; general admission at 7:30 AM. For more details, contact *Rick Reiner K6ZWB, 2120 Slater St., Santa Rosa CA 95404. Tel. (707) 575-4455.* Or write to *Sonoma County Radio Amateurs, Inc., P.O. Box 116, Santa Rosa, CA 95402.*

SEP 21–22

ANCHORAGE, AK The Anchorage ARC will celebrate its Silver Anniversary Hamfest at the Kincaid Park Outdoor Center in Anchorage. VE Exams, FCC Commercial Radio License Exams, Alaska QSL Bureau, Demos, Guest Speakers, and annual Country Store. For booths, contact *Robert Wilson AL7KK, P.O. Box 110955, Anchorage AK 99511-0955. Tel. (907) 248-0976* or *(907) 271-5304.*

VIRGINIA BEACH, VA The 21st annual Virginia Beach HamFest & Computer Fair. ARRL Roanoke Div. Convention will be held at the Pavilion Convention Center in Virginia Beach. Forums, Guest Speakers. Show hours Sat., 9 AM–5 PM and Sun., 9 AM–4 PM. No smoking allowed in the Pavilion. For more details, contact *Lewis B. Steingold W4BLO, (804) 486-3800,* or *(804) HAMFEST. FAX (804) 486-0757.*

SEP 22

ADRIAN, MI The Adrian ARC Hamfest and Computer Show will be open at the Lenawee County Fairground, 8 AM–2 PM. VE Exams, Forums, Trunk Sales. Talk-in on 145.37(-). Contact *Brian Sarkisian KG8CO, 139 N. Main St., Adrian MI 49221. Tel. (517) 265-1537;* or *E-mail: gbishop@tc3net.com.*

COTTLEVILLE, MO The St. Peters ARC Swapfest will run 7 AM–1 PM at St. Charles County Comm. College Campus, 4601 Mid Rivers Mall Dr. Flea Market, VE Exams. Talk-in on 145.41 MHz and 444.275 MHz. Contact *Jay Underdown WØOGS, 58 Judy Dr., St. Charles MO 63301. Tel. (314) 723-4200.*

SEP 26–29

ACAPULCO, MEXICO The 55th Nat'l. Convention of the Federation of Mexican Radio Experimenters (member of the IARU) will be held in Acapulco. Conferences, Workshops, Extraordinary General Assembly,

Entertainment. For details. write to *Cesar Figueroa V. XE1KFV, FMRE, Apartado Postal 907, 06000 Mexico D.F., Mexico. Tel. 011-52-5-563-1405 (from the USA). Internet: FMRE@supernet. com.mx*. Stay over at the 5-star-rated Hotel Hyatt Regency Acapulco.

SEP 27–29

WALLA WALLA, WA The W7DP Walla Walla Valley ARC will host their 50th annual Hamfest and ARRL SE Washington Sec. Convention at the Washington Nat'l Guard Armory, 113 So. Colville (corner of Colville and Poplar Sts.) in Walla Walla. Skywam Seminar, Scavenger Hunt, Flea Market, and more! Contact *David L. Pence KB7WRT, Hamfest Chairman "W7DP," P.O. Box 321, Walla Walla WA 99362;* or call *(509) 525-2529*. Talk-in on 146.960/.360.

SEP 28

ELMIRA, NY The Chemung County Fairgrounds in Horseheads **NY** will be the site for the 21st annual Elmira Internat'l Hamfest-Computerfest. The event is open 6 AM–3 PM. For VE Exams (on site at 0900), call *Bill (607) 962-1134*. Walk-ins accepted. Dealer inquiries will be handled by *Jay at (607) 733-0761*. For ticket info, contact *Dave Lewis, RD1 Box 191, Van Etten NY 14889. Tel. (607) 589-4523*. Talk-in on Rookies Rptr. 147.96/.36 or 444.20.

HUDSONVILLE, MI "Super Swap 96" will be presented by the Grand Rapids ARA Inc., 8 AM–1 PM, at Unity Christian H.S., 3487 Oak St. Talk-in on 147.26 Rptr. (94.8). Contact *Dave Devos KF8QL, 8111 Hanna Lake Rd., Caledonia MI 49316. Tel. (616) 698-7022.*

SEP 29

FRAMINGHAM, MA The Framingham ARA will hold its Fall Flea Market and Exams at Framingham H.S. on A St. Setup at 8 AM, general admission 9 AM–1 PM. To reserve tables, call *Martin Bayes AA1ON at (508) 435-0564,* and send check payable to *FARA*, to *FARA, P.O. Box 3005, Framingham MA 01701*. To register for exams, send a check for $6.05, payable to *ARRL/VEC*, to *Dick Marshall WA1KUG, 37 Lyman Rd., Framingham MA 01701*. Walk-ins will not be accepted after 10 AM. Talk-in on 147.15(+) Rptr.

YONKERS, NY A Giant Electronic Flea Market will be presented by the Metro 70 cm. Network, 9 AM–3 PM (rain or shine) at Lincoln H.S. on Kneeland Ave. Indoor Flea Market only. New and used equip. for CB operators, amateur radio operators, commercial 2-way radios, computers, stereo buffs, electronic parts and kits and much more will be on sale. VE Exams. Table setups at 7 AM. For registration call *Otto Supliski WB2SLQ, (914) 969-1053*. Talk-in on 449.425 MHz PL 156.7; 223.760 mHz PL 67.0; 146.910 Hz; and 443.350 MHz PL 156.7. Mail paid reservations to *Metro 70 CM Network, 53 Hayward St., Yonker NY 10704.*

OCT 4–5

OTTAWA, CANADA Chapter 70 will host the 1996 QCWA Internat'l Convention at the Citadel Inn at 101 Lyon St. in Ottawa. Many events are being offered to attendees. Queries may be made via *Internet: boØ75@freenet.carleton.ca. Packet: VE3GFI@VE3FD.#eon.on.can.noam*, or *telephone (613) 826-2426*. Advance reg. must be received by Sept. 16th.

OCT 5

TEMPLE, TX "Ham Expo," a Tailgate Swapfest, plus commercial vendors, will be held 7 AM–3 PM at Bell County Expo Center, Belton TX. There will be a T-Hunt at 9 AM. VE Exams for all classes starting at 1 PM. Tailgaters setup Sat., Oct. 5th at 6 AM. Commercial vendors may set up Fri., Oct. 4th, 5 PM–10 PM. There is a $10 table surcharge for early setup. Talk-in on 146.820(-) PL 123, and 147.300(-). Contact *Mike LeFan WA5EQQ, (817) 773-3590;* or *E-mail mlefan@vvm.com.*

OCT 6

SPRINGFIELD, OH The Independent Radio Assn. of Springfield will hold its annual Hamfest at the Clark County Fairgrounds, located 1/4 mi. north of Interstate 70 (exit 59) and State Route 41. The event will be open 8 AM–3 PM. For details, call *Jerry KB8FMW, (513) 568-4070*. Talk-in on 145.45(-). For reservations call *Bernie NBXKF, 9 AM–6 PM, at (513) 882-6559;* or *Bill N8XIW, 7 PM–10 PM, at (513) 324-4082.*

SPECIAL EVENT STATIONS

AUG 24–25

PETERSBURG, NE The Albion ARC will use vintage radios and equip. to operate Station KBØTLX 1800 Aug. 24th–1800 Aug. 25th to help celebrate the Nebraska State Antique Tractor and Horse Plowing Contest. Freqs.: 7.240, 14.240, 21.130 and 28.330. To receive a special QSL card, send name, address, and QSL to *Steve Wright KAØVEU, 929 Park, Albion NE 68620 USA.*

AUG 31–SEP 2

NUTLEY, NJ The Robert **D**. Grant United Labor ARA will operate KB2YCT, the Club station, along with other stations around the country, to honor the working men and women of this great nation. Connect on the General portion of 40m, 20m, 15m, and 28.420 phone-in on the Novice phone band. For a certificate, send an *SASE to station's call* and *P.O. Box 716, Nutley NJ 07110-0716 USA.*

SEP 9–14

LINWOOD, NJ Southern Counties ARA will operate K2BR Sept. 9th to Sept. 14th, from the Miss America Pageant in Atlantic City NJ. (IOTA: NA 111 - Absecon Island) Freqs.: Phone—25 kHz inside lower General class band edge. CW—65 kHz inside lower General class band edge. Novice—28.100–28.500 kHz. QSL with a #10 SASE via *SCARA, P.O. Box 121, Linwood NJ 08221 USA.*

SEP 14

EFFINGHAM, IL Effingham County, EM59. The Nat'l. Trail **ARC** will operate K9UXZ in conjunction with the annual Transportation Festival, 1 PM–8 PM CDT. Operation will be on lower General and Novice 10 meters. For a certificate and/or QSL card, SASE to *K9UXZ, Nat'l. Trail ARC, P.O. Box 903, Effingham IL 62401 USA.*

SEP 16

DANVILLE, PA Liberty-Valley Elementary School will operate KC3HP, WC3A, N3IRN, and N3LQS on the General portion of the 15m, 20m, 40m, and 75m bands, from 1300Z–1900Z. For a certificate, send QSL to *D. Miguelez N3POB, Liberty-Valley School, 175 Liberty-Valley Rd., Danville PA 17821 USA.*

SEP 19–22

LEAVENWORTH, WA Ham radio operators will operate a Special Event Station during Salmon Festival 96 using the special prefix W7F. Operation will be from the fish hatchery located at Leavenworth. Sep. 19 & 20 will be for area schools to talk with out-of-area schools. There will be contact only with ham school stations on these two days. The station will make contact with hams on the 21st & 22nd on 20m (14.252), 40m (7.252), and 75m (3855) bands. Certificates will be issued to stations contacted. Mail your QSL card to *FISH, General Delivery, Leavenworth WA 98826 USA*. All entries must be post marked before Oct. 1, 1996. There will be a prize drawing held on Sat., Oct. 5th.

SEP 28–29

CAPE COD, MA WB1U will operate 1400Z Sep. 28th–2100Z Sep. 29th, to commemorate Marconi Station's 95th Anniversary. Operation will be in the General portions of 15, 20, 40, and Novice portions of 10 and 80 meters (CW and SSB). For a certificate, send an SASE to *Ray Hilson, 6 Sherman Place, Norwalk CT 06851 USA.*

NEVER SAY DIE

Continued from page 77

legally end our old music business companies. This doesn't affect *73*, other than it'll give me more time to get on the air and have some fun and to pursue my work with cold fusion. I enjoyed the music business, but "I've been there, done that." Ten years was more than enough.

I was not surprised by the recent class action suit against the six major music companies (five are foreign-owned) for price fixing. But then the whole industry is corrupt, as I've discussed in my past editorials. The big winners are the six majors and big record store chains. The big losers are 98% of the performers, 100% of the independent record companies, and 100% of the independent record stores. Capitalism works fine until companies get big enough or work in secret groups to control distribution and prices. Lobbyist payments to Congress keeps the Feds at bay. I've testified at Congressional hearings where it was quite clear that the committee chairman was safely in the music industry's pocket. The industry people, whom I knew well, laughed about it.

The majors were candid. They hated the impact I was having in my efforts to build the market share for independent record companies, but my *CD Review* was selling about $30 million of

Continued on page 83

Heathkit Mania

And all bought at bargain prices!

Shane P. Brady WB2WPM
34 Rosewood Drive
West Seneca NY 14224

I earned my Novice license 22 years ago, after seeing a ham radio demonstration as a Boy Scout some 10 years earlier. Recently married and unable to afford new equipment, when I heard that a local ham was selling a Heathkit SB-102, I went for it. That SB-102 and a 40 meter dipole were my introduction to actual QSOs.

I remember looking through the Heathkit catalogs, trying to imagine a station with all the matching accessories for my SB-102. The XYL got me started by giving me the matching SB-630 station console for Christmas. This had a 24-hour digital clock, a phone patch, an SWR meter, and a 10-minute timer, all in one. I then added the matching SB-600 station speaker. Not a shabby-looking station for a Novice in 1974. The SB-102 is a 13-tube HF SSB/CW transceiver, rated at 180 watts input—80 watts more than most of today's radios—running a pair of 6146Bs as finals.

When I upgraded to Advanced, the SB-102 got me contacts with UA, ZS, VK, and XX. I added the optional 400 Hz filter for CW, and what a difference that filter made!

Sure, I sold the SB-102 and went on to a solid-state synthesized radio with 100 memories and computer-controlled microprocessors, but I couldn't forget my vision: to have a complete line of Heathkit radios and accessories.

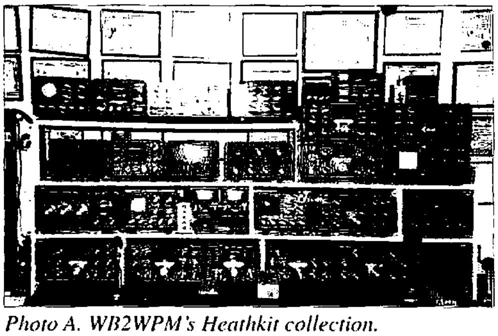

Photo A. WB2WPM's Heathkit collection.

Building the dream

Several years ago I heard about a retired ham with some old gear to sell. That visit changed my shopping habits at hamfests. There was an SB-102 and an SB-200 1 kW amplifier. The SB-200 is still an extremely popular 1 kW amplifier. It uses a pair of 572B tubes in parallel for finals. Together, the SB-102 and the SB-200 were a popular combination in the late '60s and early '70s. We worked out a great deal; he just wanted them to go to a good home and was not interested in the dollars.

> *"So what do I do with all of this outdated equipment? I have fun with it!"*

Clearing a spot on a side table, I made a new home for my old friends. I had kept my SB-600 speaker and SB-630 console; these too joined the new family.

As a Novice in the early '70s, it seemed to me that four out of five QSOs were with hams who had Heathkit equipment. Now, in the 1990s, I was trying to make contacts like I did 20 years ago, with so-called obsolete equipment.

Does that Heathkit combination still work? You bet it does! No, it doesn't have the 100 memories, and I do have to wait a couple of minutes for the tubes to heat up. But what it does very well is make contacts. You're not going to hear signals coming in at less than 0.1 µV on a crowded band, but how often are you really under those conditions? Remember, a clean signal from 20 years ago still sounds the same as a clean signal from a state-of-the-art transmitter today.

Finding the pieces

At a local ham auction, I ran across an SB-610 monitor scope which also matched the famous Heathkit "SB green line" of equipment. Now I had five matching pieces from the SB line. The station was starting to look like the Heathkit catalogs of 20 years ago. I was hooked. I had to have *all* the pieces to the Heathkit SB line!

Packet radio is a nice way to find "wanted" equipment, and I've had great success finding bargains for older equipment. A couple of messages out on packet and soon I had added the SB-650 digital (nixie-tubes) frequency display and the SB-620 spectrum analyzer, for under $25 each. Yes, they both worked when I plugged them in. Another packet request and I had two SB-500 2 meter transverters added to my collection (at next-to-nothing prices). The SB-500 also uses 6146 finals for 50 watts output for SSB and CW.

The next piece took some ads in the ham classifieds. I had only seen one SB-640 in my life, and that was years ago at Dayton. The SB-640 is a remote VFO that interfaces with the SB line of transceivers for working split frequency.

The hardest piece to locate was the SB-110 6 meter transceiver. Most people hang on to these '60s vintage rigs, which use 6146 tubes for finals for 180 watts PEP on SSB and 150 watts CW.

Hamfests will yield a bumper crop of old tube-type Heath equipment. I've purchased complete working HF rigs for $20!

I've since added the SB-300 and SB-303 receivers, along with their

Photo B. WB2WPM at his station. *Photos by WB2JFP*

matching SB-400 and SB-401 transmitters, to the collection. These twins were known as the "poor-man's Collins." HW-100s and HW-101s have joined the family as well, along with many green accessories such as wattmeters, phone patches, keyers, and SWR bridges.

No, not everything works when I get it, but in most cases all that is required is replacing a tube or two and a quick tune-up. At hamfests there are always boxes of tubes for sale. The average price for a tube is $2, but many times they can be found for only $1.

Manuals are worth their weight in gold when working on this older equipment. I make copies of all manuals and store them away. I'm even collecting manuals for equipment I don't have yet, just in case I come across it someday. With the manuals, tune-ups are a cinch, as in most cases all you need is a known frequency source and a VOM. Heathkit's famous step-by-step instructions will lead you through complete tune-ups, if need be.

Naturally, I've added Heath's last line of SB equipment to my collection. At another operating position, sits the all-solid-state SB-104A transceiver and its matching SB-604 speaker and power supply, the SB-614 monitor scope, and the SB-634 station console and its matching SB-644A remote VFO. All working, and all obtained at bargain prices.

So what do I do with all of this outdated equipment? I have fun with it! When visitors come to the shack, most are in awe of all those dials and gleaming knobs. It's almost a shame to tell them that, averaged out, I have less than $35 per piece invested in this sub-hobby. That's less than a used state-of-the-art rig!

Am I finished with my collecting? No way. There is still an SB-313 shortwave receiver out there waiting for me, the last piece I'm missing for my collection! Besides, I still need more basket cases to combine with other basket cases, to come up with working units. Why do I need more and what am I going to do with all of these Heathkit radios? Funny, that's what N2INY, my XYL, asks.

"When visitors come to the shack, most are in awe of all those dials and gleaming knobs."

Number 82 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
c/o 73 Magazine
70 Route 202 North
Peterborough NH 03458

Things That Go "Woof"

This month, we're going to take a look at the kinds of problems that give service technicians nightmares; the ones which keep the antacid business booming. I'm talking about "tough dogs," those unusual repair problems that, in the long run, aren't unusual enough! Here are a few I recently ran into and solved.

Yes and no

This one was a 2 meter HT that wouldn't transmit—sometimes. Sometimes it would work just fine, but then I'd press the PTT again and the transmit light would just flash for a fraction of a second and go out, resulting in no RF output. Receive was fine. Bad connection, right? I couldn't find one, and wiggling and tapping things had no effect. Once it started transmitting, it would continue for as long as the PTT was held down, but the next attempt might or might not work.

This baby was pretty much screaming "woof! woof!" but I was determined to figure it out. I poked, prodded and couldn't get anywhere. The mystery finally started to unravel, though, when I noticed that the problem only showed up when the radio was in simplex mode; using an offset in either direction made the transmitter work fine every time. Now I was getting somewhere! It had to be in the offset switch, I figured. I checked the switch, and even jumped it just to be sure, but it made no difference. I put the radio down on the bench and pondered that one for a while. OK, I had localized the problem, but what the heck could it be?

Localized ... hmmm, that had to be it! This was a pre-microprocessor radio. What difference could that make? Well, in a micro-controlled rig, offsets are selected in software; the radio simply retunes to the transmit frequency every time you press the PTT. Before micros, though, that was impossible, necessitating another approach: There were three crystals, one for each offset (up 600 kHz, down 600 kHz, and simplex), that set the frequency of a local oscillator which was then mixed with the synthesized one you set with the thumbwheel controls. That way, the circuitry and crystal-generated frequencies required to create the offset were the same, no matter what frequency you selected for operation. (That's also why non-standard offsets weren't available, as separate crystals would have been required for each of them.)

It was the word "localized" that set me thinking in that direction. Of course, an unreliable simplex offset crystal would cause all these weird symptoms. The transmit light would go out because the synthesizer would detect that the final mixed frequency was not there.

Sure enough, that was the problem. Of course, it could have been a capacitor or something else easily obtainable, but any tech can tell you that the part that needs replacing is always the hardest part to get! Furthermore, failing crystals often act just this way. Their activity level goes down, so sometimes they'll start up and sometimes they won't. A quick blast on the crystal with the freezing spray made the rig work every time, until the crystal got back up near room temperature, at which point it got "temperature-amental" again. Case solved. Another tough dog muzzled.

El Zappo

This one was a three-tube HF linear amplifier that used 8874 tubes, which are small high-power metal-ceramic types. The amp was used, and had just been shipped here. It had a serious problem: Turning it on blew its fuses almost instantly, even though the shipper swore it had worked just fine when it left! "Hard shorts" like this can be difficult to diagnose, mostly because you can't put power on the circuitry to see what's going on. As soon as you do, it blows the fuses again, and you're left with a dead circuit.

This amp used step-start protection. That is, it avoided serious inrush current to the massive power transformer by first putting all the current through a couple of resistors, and then bypassing them a moment later with a relay. The first thing I wondered was whether the power transformer had a short. That's tough to know, because the DC resistance of the windings in such a big beast is pretty low to begin with, making simple ohmmeter measurement worthless. The windings read close to zero ohms on a good transformer anyway, so there's no way to tell. I suspected, though, that the transformer was good, for three reasons: First, they almost never go bad. Second, the step-start resistors weren't fried, suggesting that the problem was on the other side of the transformer and didn't kick in until full power was applied. Finally, the meter lights came on for a fraction of a second before the fuse blew. That told me that the primary probably had to be OK, or there wouldn't have been any power at all. Of course, there still could have been a short in the high-voltage winding (which is where I'd most expect to find it).

I went around and around on this one for one or two hours, on the assumption that the transformer had no shorts. The high-voltage diodes and capacitors were all OK, and I couldn't find any shorts anywhere else, either. What the heck was shorting out and taking all that current? Could it be a shorted tube? I checked from anode to ground with my ohmmeter, but they all read open, as they should.

A quick call to the manufacturer exposed my hasty mistake. They suggested I disconnect the anode caps from all the tubes and try turning the amp on. That did it! I fired it up and it worked normally, with the correct high voltage shown on the meter. So, it was a tube after all! Turns out this kind of tube failure is common after shipment. I guess those tubes are more fragile than I'd realized. Apparently, physical shock can cause internal elements to shift just enough so they'll short out when the tube is warmed by the filament and high voltage is applied. So, they look good on an ohmmeter, but they aren't. Putting the caps back on, one at a time, exposed the bad tube. Another weird one solved, though I can't take credit for it. Woof!

> ***"I'd heard of such a thing happening in various kinds of picture tubes, but had never actually seen it."***

Déjà vu all over again

I should have recognized this problem, because I'd seen it before, albeit under very different circumstances. I have a projection TV set that came to me with similar trouble. It would turn on, but the red tube would glow so brightly it practically lit up the room, and the other two tubes barely ran at all. Of course, I couldn't leave it on long enough to work on the set because it would have destroyed the red tube. Projection tubes are about as expensive as transmitting tubes, and much harder to replace: it wouldn't have been worth keeping the set if I'd had to get a new tube.

After going over all the CRT circuitry in the red section and finding it to be the same as that in the other two (identical) sections, I concluded it had to be a short in the tube. I'd heard of such a thing happening in various kinds of picture tubes, but had never actually seen it. So, out came the old ohmmeter, but there was no short to be found; the elements all read open, as they should. Then, I had an idea. Perhaps it was a thermal short, just as I described in the linear amplifier story. I turned the set on, let it run for about 30 seconds, and then pulled the plug and yanked off the CRT socket on the red tube. Naturally, I wore

rubber gloves, because I wanted to live long enough to enjoy watching the set. I quickly measured between the filament and cathode, which were the closest two elements and the ones most subject to this sort of trouble. And there it was: My meter showed a short whose resistance quickly began to rise as the tube cooled off. Within a few seconds, it was gone! I'd found it: now, what could I do about it?

Unlike with transmitting tubes, this type of short can be circumvented in CRTs. All you have to do is isolate the filament, using a 6.3-volt filament transformer. That way, the tube is still shorted, but the short leads nowhere. The fix worked fine, and the set is still going strong. Woof, woof!

Well, I'm dog tired just from thinking about all these tough dogs! Over the years, I've struggled with countless woofers, and I've probably learned more from them than from anything else. Naturally, nobody enjoys tough dogs, but they're out there, and I promise you'll see your share if you keep working on electronic things. I also promise you'll learn a lot.

Until next time, 73 de KB1UM.

NEVER SAY DIE

Continued from page 79

CDs a month, so they *had* to advertise. During this time the indie market share went from 4% to 14%, a gain of several billion dollars in sales.

I love music, but I didn't want to spend the rest of my life reviewing new CD releases and giving talks at music industry conferences all around the world.

LETTERS

Continued from page 6

American hams or organizations have the right to unilaterally impose a "Morse Forever" policy on the international community; besides, wouldn't it be nice to have more DX stations to talk to? If Americans truly feel the "Morse filter" works, they would be free to pursue it on a local basis; and if they later changed their mind, they would not be able to blame it on the "international treaty problem."

None of this is meant to diminish the accomplishments of the radio pioneers; CW needs an appropriate shrine next to spark and AM. You can argue in favor of a question or two on spark transmission techniques on the test. In a real emergency, I would not hesitate to kludge a spark rig for a distress call; somehow I find it hard to imagine anyone modifying a modern IC-filled broadcast receiver in an emergency environment for practical use as a transmitter. But this letter is about current and evolving practice, and so I offer the following reality checks :

1. The Coast Guard no longer monitors Morse transmissions.

2. The armed forces no longer need Morse operators.

3. The merchant marine use of Morse is vanishing.

4. The Boy Scouts have dropped the Morse merit badge.

5. The "Morse filter" doesn't work. Check the high ends of 75 and 20 meters or "2 meter CB" in any major metropolitan area. Check how many coded licensees have actions to revoke their license as compared to "those codeless Techs." Our ARRL affiliated club could not function without the new codeless members.

6. The path of choice into the hobby is no-code. About a third of US hams are codeless. Tragically, the hobby is stagnating in growth, primarily due to the Morse requirement for frequencies below 30 MHz. This does not bode well for hams or the hobby in general, or organizations or businesses who derive their income from a healthy, young, ham radio environment.

7. It is very difficult to interest young people enough to jump the Morse hurdle, because it is an obsolete technology. Our club has been in three schools trying to start up clubs. For less money, a young person can learn a marketable job skill, gain access to useful academic information, and meet a wide range of interesting people on the Internet. If we thoughtfully consider the declining ability of our nation as a whole to compete internationally, wouldn't it be helpful to "grow" some technically savvy youngsters?

8. The ARRL has dropped the Novice Roundup (a CW contest for beginners).

For these and other reasons, I believe that no rational argument remains to retain the Morse code as an entry requirement at all. However, if the requirement remains in the ITU treaty, it is my strong feeling that the hobby would be best served by reducing the code requirements for most license classes in the US to a token recognition exam with no speed requirement at all, since that satisfies the "letter of the law." The few remaining "Morse Forever" diehards can still hang out at the low end of the band with their side-swipes, with no harm done. Don't get me wrong, I spend a lot of the limited operating time I have down there. But the choice was clear this year—buy myself a nice new rice box, or get my son the new P100 computer to succeed in school. I really worry because I find a lot of the guys I used to talk to frequently are not even on 2m, but at their keyboards. I urge all hams, the ARRL, the QCWA, and the IARU to do the right thing ... before it is too late.

There is a second important issue that should be taken up at the next WRC ('99). Forty meters, particularly in the northeast, north central, and eastern seaboard of the US after 3 p.m. local time is virtually useless for ham communication. The incursion of powerful foreign shortwave broadcasters, intentionally beaming their programs to North America in violation of agreements, is so pervasive that prosecuting any deliberate jamming of hams by hams is insignificant by comparison. The mess on 40 drives people down to the overcrowded 75m band, exacerbating the problems there. The time for dispassionate negotiation has past. This has been a problem since my entry into the hobby in 1960. As a Novice, I played by the rules and took my precious crystal apart and ground it with a slurry of Bab-O™ cleanser to get out from under the foreign BC. I suspect my friend was more rational; he didn't waste any more money on "rocks"—he built a VFO kit and used it illegally as a Novice (another example of regulations lagging far behind the state of the art).

I propose the following possible scenarios, individually or in combination:

1. Eliminate all amateur power restrictions on 7.15-7.3 MHz. This would provide those with the inclination an opportunity to gain experience constructing and operating some "world class" transmitting equipment. FCC type acceptance would prohibit band switches in commercial units at the 1.5 kW to 100 kW or higher power levels. American commercial manufacturers could turn a tidy profit with little foreign competition. Day/night restrictions, as on the old shared 160m band, could be imposed. If it creates massive QRM in Europe, tough noogies—two can play that game. This proposal is meant seriously, not in jest.

2. There is mandatory use of "split frequency" operation to work DX on 40 phone. This is simple waste of precious spectrum space. Also, the bandwidth restrictions of a compact beam rarely permit optimum performance on frequencies that are separated that far apart. Encouraging the use of optimum directive antennas would reduce interference in at least some directions. Some realignment, at least for upper-class licenses, with the international allocations seems the only sensible solution. To reduce complaints from DX operators, limit power in that segment to the same level they have: 300-400 W. It is probably heresy to suggest we extend that limit to all frequencies, as a matter of fairness. Also, it's impossible to

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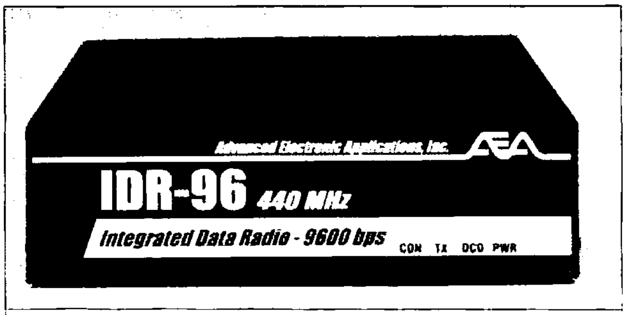
New Products



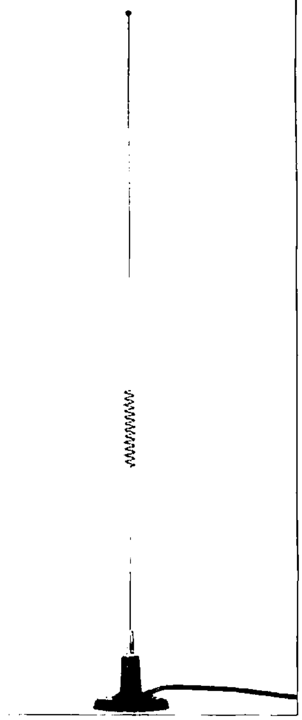
Plug and Play Packet

Advanced Electronic Applications, Inc. (AEA) has the next progression in Packet Radio—an integrated Data Radio called the IDR-96. It integrates the proven technology of the PK-96 TNC with the simplicity and high switch-over speed of a crystal-controlled radio.

The IDR-96 is a 9600 bps TNC with the features Packet users demand: full-featured mailbox; Gateway node operation; advanced Global Positioning System commands; identification of TCP/IP, TheNet, and NetROM stations; and more, for a suggested list price of $499.

The integrated radio is built into the unit, so you avoid the connection and compatibility problems associated with 9600 bps Packet; and two software programs are included with every IDR-96: PC PakRatt Lite™ and APRS™. See your dealer for best price and availability. Call AEA's Literature Request Line at (800) 432-8873 for more information on all AEA products.

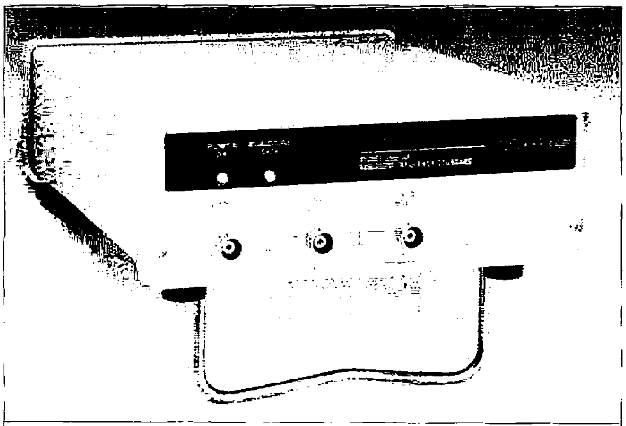
MFJ-1729 *Super*Gain™*



A powerful dual-band magnet mount antenna for ham radio is available from MFJ for only $29.95!

The MFJ-1729 *Super*Gain™* gives you 6.3 dB on 440 MHz and 2.6 dB on 2 meters—the perfect choice for dual-band mobiles and handhelds. MFJ's exclusive 29 3/4-inch stainless steel *SlimLineRadiator™* minimizes wind vibration for less SWR flutter, and besides the working advantages of the MFJ-1729, the thing just looks great! It's sleek, stylish, and the base has a pad to prevent scratches on your vehicle. Of course it comes with MFJ's *NO MATTER WHAT* one-year unconditional warranty.

For more information, contact your dealer or MFJ Enterprises, Inc., P.O. Box 494, Mississippi State MS 39762. Phone (601) 323-589, FAX (601) 323-6551, or order toll-free (800) 647-1800.



Put This on Your Wish List

The Model 2950AR Atomic Resonance Rubidium Frequency Standard from Novatech Instruments, Inc. has simultaneous sinewave outputs of 10 MHz, 1 MHz, and 100 kHz, and at $3,950.00, it's the lowest priced laboratory-type Rubidium Standard on the market. The 2950AR is ideal for use as a master oscillator in labs and ground stations as well as for tests and calibration. For more information, contact: Novatech Instruments, Inc., 1530 Eastlake Avenue E. - Suite 303, Seattle WA 98102. Call (206) 322-1562, FAX (206) 328-6904, or view the complete data sheet on their Website at http://www.eskimo.com/~ntsales.

More Power!

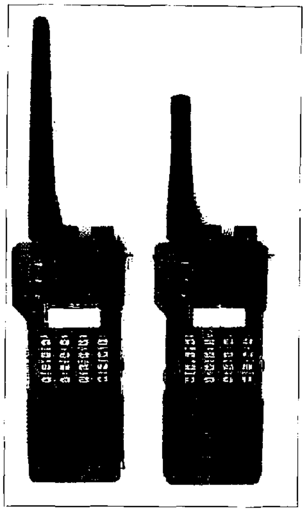
Get 50% more power on 2m and 75% more on 440 MHz than the nearest competitor offers—for $60, less! Mirage Communications Equipment BD-35 is capable of boosting your power to new levels: it features auto-band selection, single connector for dual-band radios/antennas, full duplex operation, reverse polarity protection and much, much more.

This nifty compact amplifier works with all FM handhelds up to 7 watts. You get 45 watts capability on 2m and 35 watts capability on 440 MHz, and Mirage's exclusive *FullDuplexAmp™*, which lets you talk on one band and listen on the other, just like a telephone conversation. The custom wraparound heatsink gives you excellent heat distribution and the reverse polarity protection will save your amp if you accidentally connect the power backward. A free mobile mounting bracket is included, and you get Mirage's legendary ruggedness and a full one year warranty—all for $199!

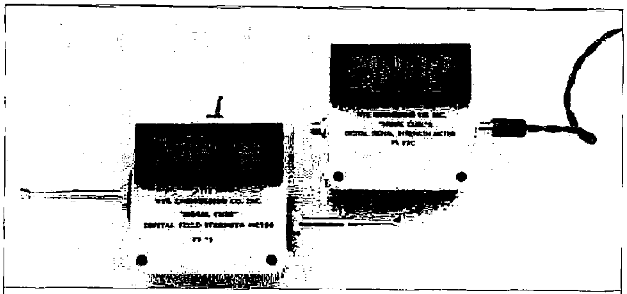
Call your dealer or Mirage Communications at (800) 647-1800 to find the dealer nearest you.

Handies are Dandies

Premier Communications has a couple of winners here, in the AT-200/2 meter and the AT-400/70 cm FM handheld transceivers. Both are equipped with easy-dial VFO, 20 memories, backlit display and DTMF keypad, 4 scan modes, dual watch and call channel. They've also got 38 tone CTCSS encoders and decoders, and DTMF paging for silent monitoring, along with lots of other goodies, but Premier emphasizes their simplicity of operation and solid reliability, something everybody looks for in a handheld. A full line of mating accessories is available.



For more information, contact Premier Communications, 20277 Valley Blvd., Walnut CA 91789; telephone (800) 666-2654; FAX (909) 869-5710.



Signal Cube® from Nye Engineering

Here's a unique little gem from Nye—a 2.5" cube unit designed as a digital repeater of the receiver's S-meter. It connects to the terminals of the receiver's analog S-meter and is powered by a built-in 9V battery. The battery will supply the unit continuously, when the on/off switch is left on, for two months. The unit can be used with hundreds of feet of cable, if required.

The digital readings are in S units 0 through 9 and in dB above S9 to 40 dB, exactly following the analog S-meter. The Signal Cube, with its half-inch digits and high resolution, is much easier to read than the regular analog S-meter.

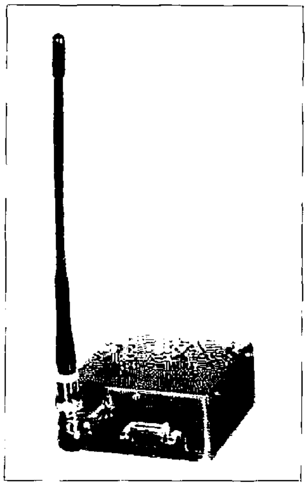
The Signal Cube is available for $189 from Nye Engineering Co. Inc., 4020 Galt Ocean Dr., Suite 606, Fort Lauderdale FL 33308. Phone (954) 566-3997 or FAX (954) 537-3534.

Xtal Set History

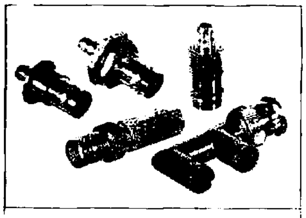
"Crystal Radio: History, Fundamentals, and Design" is a new book from the Xtal Set Society, Box 3026, St. Louis MO 63130. This 124-page, $11 paperback chronicles the history of the crystal detector. It also covers basics such as antennas, lightning protection, grounding, tuned circuits, multi-tuned circuits, wave traps, and detection. Xtal set fans will probably also want to subscribe to the Society's ($10 per year) newsletter.

Neulink 9600 Is Now a Repeater

RF Neulink is now shipping its Neulink 9600 with repeater capability, a no-cost option available in all production transceiver modems. Neulink 9600 is a high-speed, 57.4 Kbps, 9.6 Kbps over-the-air, 2 watt transceiver modem. With its 65,000 unique ID codes, this synthesized UHF modem is capable of point to point and point to multipoint networking. It is an intelligent modem that has the capability to call up the entire network, group calling, or any individual remote in the system. Protocol is full handshake and includes RTS, CTS, DSR and DCD as well as error detection and correction.



For more information, contact RF Industries, Neulink Division, 7610 Miramar Road, San Diego CA 92126-4202. Telephone (800) 233-1728, FAX (619) 549-6345, or E-mail: 102061.2261@compuserve.com.



New 75Ω Connectors

RF Connectors, a division of RF Industries, introduces its new line of 75 ohm connectors.

This series of coaxial connectors include 75 ohm BNC adapters and cable connectors. These connectors are available with both nickel and silver plating, Delrin and Teflon dielectric and all feature gold-plated captivated center contacts.

These new connectors are available from RF Connector Distributors throughout the US, Canada and Mexico. For a complete listing of 75 ohm adapters and connectors, product specifications and availability, call (800) 233-1728 or E-mail: 102061.2261@compuserve.com.

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The Last Skeptic of Science by René. We all know there have been a bunch of ice ages, right? Wrongo, says René! And that the moon causes the tides. That volcanoes are caused by magma leaking from the earth's core. That the transmutation of elements is difficult. That the earth, with it's iron core is a big magnet. Plus a bunch of other blasphemies, which René disproves most convincingly. Heck, we all know that two materials of different weight will fall at the same speed in a vacuum. Galileo proved that once and for all. Could Galileo have been wrong? You betcha. René spins out one after another of thoroughly accepted scientific truths and slays them. Boy, will you have things to talk about after reading this baby! 179p, 81/2 x 11. Order **SK** $25 from Radio Bookshop.

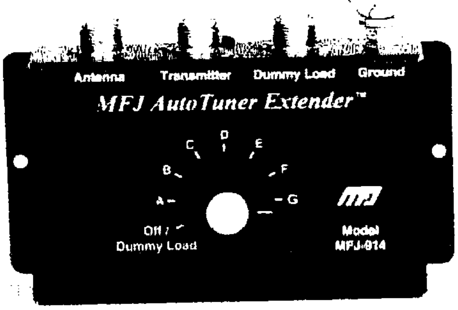
NASA Mooned America by René. The proposition that the Apollo flights were all faked and NASA never got anyone to the moon is patently ridiculous. I'm still waiting to hear from anyone who has read this book and still believes the moon landings weren't the biggest hoax in history. René has done his homework thoroughly and cites 30 darned good reasons why he thinks we've all been lied to. 176p, 8 1/2 x 11. Order **NA** $25 from Radio Bookshop.

Cold Fusion. Look, you ignored my blandishments to get involved with repeaters, which would have led you into getting rich via cellular telephones. Then you ignored my pleas to get involved with personal computers. So you're not a Bill Gates, Paul Allen, or Steve Jobs. You can't say I didn't try. The next biggie is going to be cold fusion. You can get an Overview report on the subject for $2 (order **CFO**) from Radio Bookshop. Or you can jump in and subscribe for 12 issues. The special *73* subscriber rate is $75 instead of $98. Warning, some of the articles are technical, some are on experimental systems. Order **CF-sub** from Radio Bookshop. Motorola and Bechtel are already jumping in on this new technology, yet the leading American researcher in the field had his lab in his garage and had less than $5,000 invested. He's now working for Clean Energy Technology Inc. (CETI).

The Book List by Wayne Green. This is a list of 83 books that I say you are absolutely crazy if you don't read. And none of this "I don't have time to read" crapola. These books are the best books I've found in a whole bunch of fields. Many were recommended by readers as being top notch. It's time to become educated on health matters, our school system, our corrupt government, history, science, communicating with plants and animals, child development, the occult, and so on. Order **BL** $5 from Radio Bookshop.

AIDS Cure. Can a simple $19 electrical (for the parts) gadget you should be able to build in an hour cure the dread "incurable" AIDS virus? Plus clean out any other virus, microbe, yeast, parasite, or fungus in the blood? This approach was discovered by the Albert Einstein College of Medicine and then kept secret. The medical industry's worst nightmare is a cheap cure for expensive diseases. Are tens of thousands of people dying unnecessarily? This has the original Beck device, plus a reprint of the May *73* Miller unit. Can this even cause a weight loss for fatties? And can the magnetic pulse unit used to zap the HIV virus out of lymph glands be used to regrow male pattern baldness? Order **AIDS** $10 from Radio Bookshop.

More New Products



MFJ-914 *AutoTunerExtender™*

Now you can match nearly any antenna automatically! The MFJ-914 is a heavy-duty wide-range impedance transforming device, carefully designed for the flattest frequency response and the lowest loss—it will transform your antenna impedance up or down by as much as ten times, and it's only $59.95!

Extremely easy to use, the MFJ-914 can be used with any transceiver from 160 through ten meters at up to 300 watts. It connects between your transmitter and antenna with supplied SO-239 connectors—just bypass your transmitter's auto tuner and adjust the knobs on the MFJ-914.

For more information or to order, contact your dealer or MFJ Enterprises, Inc., P.O. Box 494, Mississippi State MS 39762 or call (601) 323-5869, or (800) 647-1800; or FAX (601) 323-6551.

Tape-Jay™ Stealth 2m J-Pole from HAMCO

HAMCO, an acronym for *Hidden Antenna Manufacturing Company*, is living up to the name with a new concealed antenna for 2-meter FM aficionados. *Tape-Jay* is just the ticket to get the HT and base units into the repeater from fringe areas. It is made from 3.5 mil sticky-back copper foil, and will adhere to almost any household material—windows, walls, chimneys, or even fabric, to make a portable roll-up J-Pole.

The easy-to-assemble kit comes with pre-cut elements, coax connector, cable clips and clear assembly instructions. No soldering, no special tools required. It's strong, durable, usable indoors or out, and like all HAMCO *TapeTenna™* products, you can paint it to match your mounting surface and render it virtually invisible! Order for $19 plus $4 S&H by check or money order from HAMCO, Dept. A3, P.O. Box 25, Woodland Park CO 80866.

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

September promises to be a good month for HF band propagation. Seasonal conditions are improving and, hopefully, solar flux will begin to rise again after a long period of 60s and 70s, although sunspot minimum has barely passed.

The only Poor (P) times this month surround the 14th and 27th, with possible atmospheric as well as ionospheric disturbances. As we're well aware, this is still hurricane season, so keep a sharp lookout for the possibility of tropical storms on or near these two days.

The week of the 6th to the 13th is likely to be the best week during the month, with Good (G) conditions on the HF bands. The remainder of the days are expected to be Fair or trending, as you can see from the calendar.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40			20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

SEPTEMBER 1996

SUN	MON	TUE	WED	THU	FRI	SAT
1 G-F	2 F	3 F	4 F	5 F-G	6 G	7 G
8 G	9 G	10 G	11 G	12 G-F	13 F-P	14 P
15 P-F	16 F-G	17 G	18 G-F	19 F	20 F	21 F-G
22 G	23 G-F	24 F	25 F-P	26 P	27 P-F	28 F
29 F-G	30 G					

10-12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15-17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the U.S.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30-40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. W1XU.

LETTERS

Continued from page 83

enforce. But it would be a big step in reducing RFI to consumer goods and QRM due to habitual widespread use of more than the necessary power to sustain communications (even by well-known ARRL OO stations ... clean up your own act, guys!) Maybe a few surprise FCC inspections are in order after passing rules stating possession of such high power amplifiers is prima facie evidence of power limit violation.

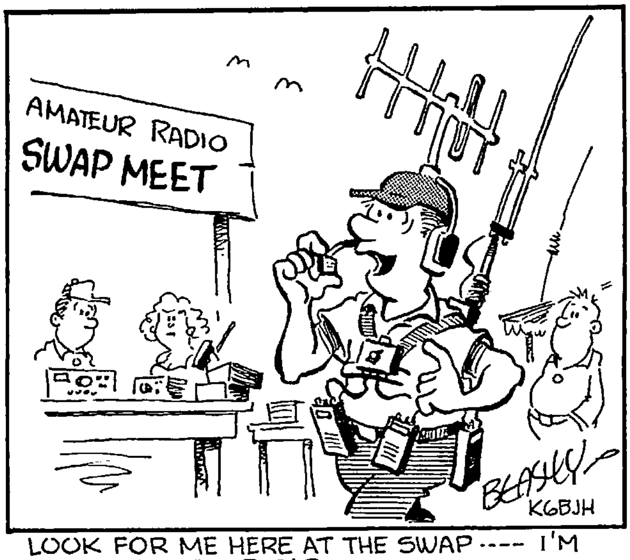
3. In view of the declining Novice ranks, consider dropping the 40m Novice CW allocation and expanding the phone band downward for Generals. I am sure some other frequencies would be a fair exchange for the Novices—how about giving them 25 kHz of AM/SSB at 7.275-7.3 in exchange? It is open throughout the sunspot cycle, unlike 10m. The AM privileges might encourage them to restore or build simple equipment and progress in the hobby. Some real phone privileges might whet their appetite for a General upgrade. Otherwise, consider dropping the Novice class altogether or merging it with Tech, once the code requirement is eliminated. (In reality, there are too many classes of license. Novice and Tech should be merged, as an entry level class. Leave General the way it is. Merge Advanced and Extra. Think up some names that are less goofy sounding, like class A, B, and C. The no-code Advanced guys won't clutter up the bottom 25 kHz code segment and bother us old buzzards anyway. Make the lower 25 kHz an exclusive CW-only segment to keep those pesky bit bangers out, if you are worried about it, but are you really sure that guy with the new call that blew your ears off with the 45 wpm CW wasn't using a key that said IBM on the front? Let's get real!

4. If the rumored expansion or trade of 6.9-7.0 MHz for the largely wasted upper end of 40 comes through, let's consider something sane this time for a change as far as subband operating modes. Consider something fresh, like making the low end from 6.9 for phone, a 7.0-7.025 a CW window, a digital modes segment, an "internationally aligned" segment phone portion for upper classes, possibly putting the general CW or digital segment on the top end, where they can compete successfully with the foreign broadcast. (Think of the strong commercial incentive to move to a quieter frequency when listeners complain about multiple 1 kHz beat notes from a bunch of kW CW stations. But with a good filter, they aren't going to bother hams at all. "Please" didn't work; let's try something new.)

5. Here is something really radical: Eliminate all subbands on 40 meters altogether. That way, the more popular modes will spread out as needed, without the constant expensive "tweaking" of regulations. It seems to work OK on 160m. During the 160 CW contest the "CW band" magically grew all the way past 1925 kHz. Two days later, it shrunk back to the old 20 kHz bottom. The sun still came up. In fact, many foreign countries don't have any subbands at all. The downside is that we might have to make up some meaningful license test questions instead of mindlessly memorizing the junk on a chart everyone keeps at their operating positions. Hmmm ... the other bands? Nahhh! Too easy!

These suggestions, while offered in a humorous way, are meant as serious alternatives to the perpetuating of a problem which has been around as long as I have been in the hobby. Let's fix it this time, either through the ARRL and FASC, or take it on internationally if necessary, in spite of the resistance to change from here in the US. We could lose our frequencies due to lack of use, or due to selling of new ham gear (at truck stops) to bootleggers. I am bothered by the fact that I have not received any sort of opinion poll regarding the Morse issue, nor do I know anyone who has. I had to call ARRL HQ in order to find out who to write to, though the article I mentioned at the beginning of the letter seemed to invite comments. I hope this is not the sign of "business as usual" from the "Morse Forever" bunch. This could be our last opportunity to set a number of critical matters right.

Troublemaker. You're trying to use reason to argue what is a religious matter. Waste of time... Wayne



LOOK FOR ME HERE AT THE SWAP ---- I'M WEARING A BLUE CAP

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73 Amateur Radio Today

OCTOBER 1996
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Including Ham Radio Fun!

OCTOBER 1996
ISSUE #433

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On the cover: VE6 Field Day: VE6LHW, VE6LGP, VE6BJE, VE6SKT and VE6RHS in action. Photo submitted by Earl Grotzki VE6ERL.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Number 1 on your Feedback card

Never say die

Wayne Green W2NSD/1

Bioelectrifier Update

The May article by WA8YKN has generated a good deal of controversy. FAR Circuits is making a circuit board for the unit and has been doing a brisk business. One chap in Hollywood with a number of friends with AIDS bought a bunch of boards and put them together for his friends.

In another couple of months I hope we'll have laboratory-confirmed AIDS cures to report. One fellow, who was in bad shape with AIDS, used the unit for several weeks, then called Mike (who makes the units commercially) to say he had astounded his doctor by rebuilding his T-cell count. Another chap had a mother who was all bent over with Lyme disease. Two weeks later she was in excellent health and walking straight. But these, and a bunch more, are just anecdotes. I want to see carefully done lab reports of before and after. If this is the placebo effect, it sure seems to be powerful.

Mike reported one other effect. The unit apparently raises the temperature of the blood, which may also help to discourage viruses, as well as the 50 µA hotfoot.

Mike sent me a copy of his Bob Beck-approved circuit, which is a little different from the Miller circuit in the May issue. Let me know if you're interested in my publishing it.

Diplomacy

Details are seeping out of the meeting between the League and the representatives of the group asking that the ham 144 and 450 bands be re-allocated for low Earth orbit (LEO) satellite communications. The League team went into the meeting angry as hell over the audacity of a commercial group even suggesting such a thing. Either they take the two ham bands off their list right now or the League would sic the hams on them and Congress.

Our beloved postal service is already making billions delivering tons of such complaints to Congress from citizens whipped into a letter-writing frenzy by the professional lobby groups, so what's a few thousand more? Big deal! The LEO group was unimpressed.

So El League-o ran an editorial in *QST* asking the members to flood the LEO group, the FCC and Congress with mail. This was repeated in hundreds of obedient club newsletters, with apparently no one involved giving any thought to the ramifications. Well, people often do really stupid things when they get mad, and the Leagsters were not just mad, they were outraged.

The predictable happened. The LEO group was not only not intimidated by the mail, they got mad and their interest in a diplomatic solution to the problem blew away as the war escalated.

The League initiated a war. An unnecessary war. Worse, they did it without any real ammunition. The League seems to have forgotten that amateur radio, for all the "service" rhetoric in the FCC rules, is a hobby, pure and simple. Oh sure, within my memory amateur radio contributed to the advance of communications technology, and helped save our country's collective ass in WWII by supplying some 40,000 hams for the military. But on a "what have you done for us lately" basis, we are running on empty.

Of course if you count providing communications for walkathons as public service, then we get a few Brownie points. Let me ask a question. How many of you even know a ham who has provided a valuable emergency service in the last five years? I doubt that 1% of us has provided a truly valuable public service in years.

The courts, by the way, have rejected our claim of being a service and have ruled that amateur radio is a hobby. Well, our courts aren't always wrong.

From the FCC's viewpoint we're a whole lot of trouble and expense, with few redeeming qualities. And please remember that like most of us, gratitude is one of the FCC Commissioner's least-felt emotions. So the marvelous things we were doing before the League's even less-thought-out "Incentive Licensing" debacle of 30 years ago gutted the hobby (and the industry), are no longer even talking points, much less ammunition for a war with commercial interests.

If the League officers and directors would get over their unfounded feelings of self-importance and recognize that the reality is that they are the publishers of a ham magazine devoted to a hobby which is of interest primarily to elderly white men, they might be in a better position to deal with what is obviously going to be a flood of seekers after our bands.

Sure, there are things the League could do which could rebuild the value of amateur radio as a true service, and I've discussed these in my editorials. But I haven't seen even a hint that the League (aka *QST*) is open to making any changes which would help our (and their) future.

Old QSLs

While looking through some boxes in the barn I came across a carton of old QSLs. Ah, memories. I'll never forget the morning in 1947 when I heard a faint signal in the 20m DX band calling CQ. I heard "W...portable...." i couldn't make out the call or where he was portable so I called "W question, portable question" a couple of times and stood by. His signal gradually got better and I found I was in contact with W7IMW/C7 in Tientsin, China. Wow! Bill was modulating a 10th-watt signal generator and using a longwire. AM, of course. His penny postcard arrived via an FPO in China. My signal with a kW was only S-5, so you can imagine how weak his was. Talk about QRP!

The PK1AW card isn't very remarkable except that I made the contact as a result of a CQ call for Asia. I'd just finished a round table where we had stations on five continents. I needed that sixth for a 20-minute WAC, so I called CQ Asia and back came PK1AW. A small coup, but memorable.

I also ran across some cards left over from my operating on Fiji, Tahiti, and the Samoan Islands. No, I won't forget one minute of those DX operations.

If I'd Only Known Then What I Know Now!

You *would* have known then—if you'd read my editorials. So I don't want to hear you whining when you have a heart attack, a stroke, or I visit you when you're tied to a rocking chair in a nursing home (like they did to my mother). But no,

Continued on page 13

LETTERS

From the Ham Shack

Mike Woolard KE4MTM/DA4WM. I must say that I look forward to getting your magazine in the mail every month, second only to my paycheck. After reading your "Welcome Newcomers" column in January, I'm sure that the majority of the Techs shown in your graph felt put down! Please stop calling us CBers. We have as much ambition, interest, and learning ability as the next guy. I am now in my 40s, and a respectable GS-12 with the government as an Equipment Specialist. While I respect the skill and talent required in both golf and code, and see the enjoyment offered in both, for me and others they're about as interesting as watching mud dry! Don't take me wrong. I'm not knocking either one, they're just not appealing to everyone. Back in 1976 I got sick of CB but interested in electronics. I bought a used ham rig, book, code tape, and went for it. In a short time I was ready to ace the written test, but I had trouble with the code. Eventually I sold everything. In 1990 I heard that the code requirement had been dropped for the Tech license and there was a world of things I could get into—like packet, satellites, etc. In 1991 I took my no-code Tech exam in Savannah. My son (then 15) followed suit, prompting my wife to get her license as well. Meanwhile, I practiced the code, passed my written General exam, practiced the code, learned my Advanced material, and practiced the code! I know every square inch of the 10 wpm wall. Perhaps my trouble is ... I never intend to use code. I don't know; it's just a means to an end for me, and a silly one. Now I'm in Vilseck, Germany, and work right across from the MARS station, where I thought I would find a few hams. These young men do everything: packet, satellites, HF, digi-pictures, and have some real nice equipment. Yet, I haven't met one person there so far who knows code or what the ARRL is! I want to learn theory, application, fundamentals, and the like, not the code! I am never going to walk around with a key in my pocket, or report an accident with a key. With so much to learn, I prefer to use my time learning theory, thank you. I still enjoy turning on my Yaesu on 20m to listen, and would enjoy getting on if I could.

Two points, Mike. One, as I explained in my editorial, the license statistics tell us loud and clear that no-code Techs are not upgrading. There has been an enormous growth in the Tech ranks, and no change in the General growth. Second, if you have reached a code plateau that's proof positive that you have not been paying any attention to my editorials. With my code learning system there is no wall, no plateau. You and tens of thousands of Techs are being frustrated by trying to learn code the ARRL way (and most other code courses too), where you start slow and gradually speed up. That is a terrible way to try and learn the code. In a few hours, almost anyone can copy code at 20 wpm. Forcing you to learn the code is the ham radio form of hazing, like being paddled to join a college fraternity. And, for many, it's almost as painful ... Wayne.

Peter Bergman NØBLX. Thanks for the tip about cayenne pepper. I don't know what else it does for me, but it sure helps with my sinus problems.

I'm getting tired of the whining about the code. Like you've said many times, it isn't that tough to learn if you really want to. Unlike theory, code classes can coach you, but you have to learn it yourself. My biggest thing right now is coaching my six-year-old daughter for the Novice ticket. She nearly made the written on her first try! As a result, two of my junior ops and my XYL are working on it.

Have you read Temple's *Sirius Mystery*? It's the most scholarly book I've seen in the anomalous knowledge field.

Yes, I have the Temple book. I've also seen a couple of excellent TV reports on this incredible report on extraterrestrial contact. I may add this to my list of books you're crazy if you don't read. This is part of my fairly fruitless effort to get people to become better educated ... Wayne.

Roy Pollitt KD4HC. Wayne, your editorial in the August issue was dead-on and highly appropriate for amateur radio circa 1996. The Atlanta Hamfest, from what you described, sounds like just another proof of the impending demise of our hobby. The signs are all around: (1) No real participation or interest by anyone under the age of 30. (2) No activity on the non-phone portion of the low bands (160m through 40 m), 75% of the 24-hour day. (3) Club activity in most areas is either dull or non-existent. (4) Cliques and good-ol'-boy networks on VHF-FM. (5) The cancellation of the Novice Roundup due to a lack of interest. (6) The transformation of ham radio into CB.

I have not attended a hamfest since 1992 because I've heard nothing but complaints about hamfests from other hams since 1985, and the complaints keep getting stronger and more detailed. Why should I drive miles and spend money on a motel room, only to find a hamfest similar to the one you described in Atlanta? Ham radio community, wake up—the end is near, unless we do something to turn the situation around.

Some suggestions: Make sure your local and school libraries are well stocked with ham magazines and books (a good club project). Find an active local club and join it. If there isn't any, start one. Get on the air and do something more than rag-chew. Start sending QSLs for your new contacts. And join the ARRL. Sure, the League has done some stupid things, but how can you influence them if you are on the outside looking in? Join and make your viewpoints heard.

Those are some good ideas for attracting newcomers, but that isn't going to make hamfests more fun. Hamfest committees are running on empty when it comes to ideas, despite my many suggestions in past editorials. Hamfests have hardly changed since my first hamfest in 1938. One more thing: In the almost 60 years I've been an ARRL member I can't recall a time when the members were paid any attention. Most of the ARRL directors I've known have held the members in contempt as sheep. You have a lot more clout as a prospective member they have to woo. Once they have your money, you've lost your clout (voice). Please remember that the ARRL is primarily a multimillion-dollar publishing business ... Wayne.

Mike Grimes K5MLG. It is rare that an author can write about complex concepts using simple, understandable terms and be interesting without talking down to the reader. Such is the case with Peter Stark and his series of articles, "Communications Simplified."

I would like you to know how much I am enjoying the series and his approach. I have covered the literature for many years, and even though I am not a beginner, this series has been one of the best and well-written I have ever encountered. The illustrations and analogies support the ideas extremely well; and, although I know the subject, it held my attention, was not boring, and expanded my understanding. He must be an excellent teacher at the community college!

Thanks for an interesting set of articles. I hope there will be more.

Robert White DDS I read the "Bioelectrofier" article, which one of my referral patients brought to me, with great interest. He was referred by Paul Keys DDS, who is undoubtedly the world's foremost infectious disease expert in the dental field. Unfortunately, tooth decay and gum diseases have been treated, and continue to be treated, primarily as non-infectious diseases. In other words, dentistry targets fixing the damage, not finding the causes, which are specific microbes, fungi, protozoans ... maybe even viruses. I'd like to get a Bioelectrofier so I can begin to further my research with electrical current therapy.

QRX . . .

Toby Metz KB7UIM named 1996 "Young Ham of the Year"

(Saugus CA) Toby Metz, a 16-year-old amateur radio operator from Meridian, Idaho and Agoura Hills, California, has been named the 1996 "Young Ham of the Year," according to Award Administrator Bill Pasternak WA6ITF. The award is jointly sponsored by Pasternak's Saugus, California-based *Amateur Radio Newsline*, Yaesu USA Corporation of Cerritos, California, and *CQ* Magazine of Hicksville, New York.

Metz, whose ham radio callsign is KB7UIM, recently moved to California from Idaho. He was selected based on his work with introducing amateur radio to the deaf in the community of Boise, Idaho. Toby explained that his involvement with the deaf came as the result of a scouting project that quickly became a public service.

"I knew I needed an Eagle project, so I began brainstorming with my friend Rich Dees (AA7WG) on how I could bring the handicapped into this picture while also using ham radio. We began talking about the possible ways that the deaf might use ham radio and realized that it would be natural for them to use packet radio."

Toby decided to start a ham radio training class for the deaf. He enlisted the help of a woman from his church who worked with deaf people in Boise. Through Toby's perseverance and her assistance, a small but enthusiastic training class came into being. Metz says that it was a class that quickly grew.

"We started off with three people but the class became larger when family members decided to come as well...(one student) even learned code using a device that converts sound to vibration that you can feel with your fingers."

Toby Metz's Eagle Scout project drew praise from the handicapped community in Boise. It also brought Toby to national prominence when he was asked to write up the project for last November's *73* magazine.

In addition to his work with the deaf, Toby assisted in the creation of a Ham Radio Explorer Scout Post in Meridian Idaho and spent over a year hosting an on-air discussion group known as the "Discovery Net." Toby presided over this gathering until a few nights before he departed Idaho late this spring. At its peak, Toby's "Discovery Net" had almost three dozen ham radio operators taking part.

New to southern California, and now a student at Agoura Hills High School, Toby says that two of his priorities are joining another ham radio club similar to the one he enjoyed in Boise and to become an Explorer Scout.

"Now I am interested in the adventure aspect [of scouting]. I want to do high-adventure camping, 50-mile hikes, rafting, and those kinds of things."

Toby Metz was nominated by Rich Dees (AA7WG) of Meridian, Idaho. Dees, who helped bring Toby into the exciting world of Amateur Radio, describes his young protégé as a born leader.

"Toby Metz KB7UIM epitomizes what young folks need to be like today. He is a hardworking young man and one of his goals is to make a difference. He took on a project aimed at making a difference [in these peoples' lives] and he did," says Dees.

Dees adds that Toby continues to want to make a difference in the world: "... and I think that young people need that as a role model."

Metz will receive his award on August 17th at the Huntsville (AL) Hamfest Grand Banquet. The presentation of the award as a regular feature of this prestigious amateur radio convention has been made possible through the generosity and kindness of the Huntsville Hamfest Planning Committee and its chairman, Scotty Neustadter N4PYD.

Making the presentation will be *Newsline* producer Bill Pasternak WA6ITF and Judging Committee chairman Larry Zettwoch KR4IF, along with representatives of Yaesu USA Corporation and *CQ Magazine*. These two companies are the corporate underwriters of the "Young Ham of the Year" award. They will be joined by three former award winners: Kevin Boudreaux N5XMH (1993), Allison Zettwoch KD4CKP (1994), and Adam Weyhaupt N9MEZ (1995).

As "Young Ham of the Year," Metz will receive (courtesy of Yaesu USA) an expense-paid trip to the 1996 Huntsville Hamfest along with a gift of Yaesu ham radio equipment. *CQ Magazine* will treat Toby to a week at Spacecamp-Huntsville, and will present him with a variety of *CQ* products. *Newsline* will provide Adam with a commemorative plaque at the award ceremony.

Both corporate underwriters of the "*Newsline* Young Ham of the Year Award" are world leaders in their respective areas of amateur radio product support. Yaesu U.S.A. Corporation is a trailblazer in the design, manufacture and distribution of high quality amateur and commercial two-way radio equipment. *CQ Magazine* is published by CQ Communications, Inc.

On learning of the selection of Toby Metz as this year's winner, Kevin Karamanos WD6DIH, Yaesu's Amateur Radio National Sales Manager, released a statement congratulating him.

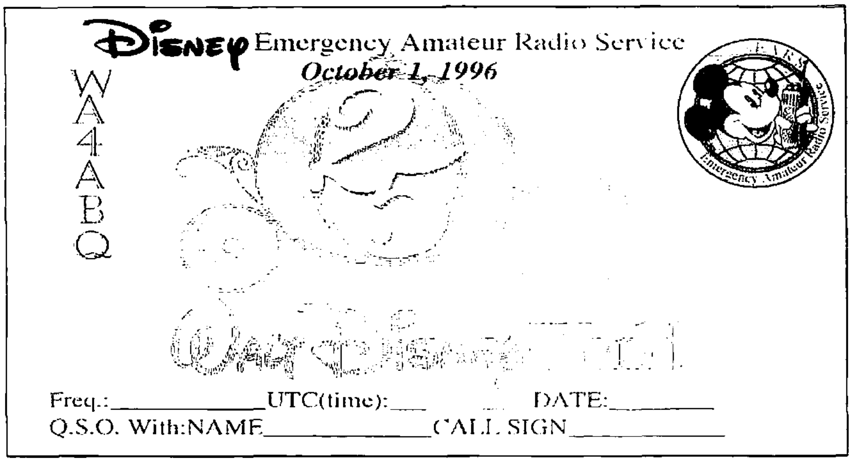
Karamanos said: "Yaesu is pleased to see so many fine young people nominated for this award and who have become so deeply involved with Amateur Radio. This is the primary reason that we support this award program. To us, Toby Metz is an excellent example of today's American youth and we join with all of the nation's radio amateurs, young and old, in commending him on his great public service and other achievements at such a young age."

CQ Publisher Richard Ross K2MGA agreed with nominator Rich Dees that Toby sets a good example for American youth: "Any time you worry about the youth of this country, and the kids with problems who are so often in the news," Ross commented, "you can look at kids like Toby and take heart. The kids in trouble are not typical. And while Toby is not typical, either, you realize that there are many more young people out there who are like Toby than those who are like the kids in trouble. They are tomorrow's mainstream and tomorrow's leaders."

The Amateur Radio Newsline is the premiere on-the-air news and information service to the worldwide ham radio community. The *Newsline* "Young Ham of the Year" award program, (formerly the *Westlink Report* "Young Ham of the Year") now entering its second decade, is presented annually to a licensed radio amateur who is 18 years of age or younger and who has provided outstanding service to the nation, his community or the betterment of the state of the art in communications through the amateur radio hobby/service.

Past recipients of the "Young Ham" award include Shawn Alan Wakefield WK5P, of Bartlesville, Oklahoma (1986); David Rosenman KA9PMK, of Muncie, Indiana (1987); Jonathan Binstock NK3D, of Potomac, Maryland (1988); Erin McGinnis KAØWTE, of Topeka, Kansas (1989); Mary Atestra KB2IGG, of Staten Island, New York (1990); Richard S. "Sammy" Garrett AAOCR, of St. Louis, Missouri (1991); and Angela "Angie" Fischer KBØHXY, also of St. Louis (1992); Kevin Boudreaux N5XMH, of New Orleans, Louisiana (1993); Allison Daneen Zettwoch KD4CKP, of Louisville, Kentucky (1994); and Adam Weyhaupt N9MEZ of Alton, Illinois(1995).

TNX to Bill Pasternak WA6ITF.



Isn't that just the DEARest thing?

D.E.A.R.S., Disney Emergency Amateur Radio Service, marks its 25th anniversary of public service this year. Does everybody have to transmit using the Mickey voice?

Ultimate Power!

Station power from a dead UPS.

Paul Blum KF9GQ
1138 Cardinal Lane
Green Bay WI 54313

One of the main reasons I became a ham is that I love to build elec tronic gadgets. This hobby gives me plenty of excuses to build things to better equip my station. Sometimes the gadgets I build actually work, and occasionally I build something that turns out better than "store-bought."

Recently I was offered a broken UPS (Uninterruptible Power Supply) for the right price (free). I gladly took it, thinking of salvaging some parts and that maybe the gel cells were OK (a free battery for my QRP rig!).

The unit sat around collecting dust for a while, until one day as I was cleaning up the shop I noticed it and decided to pop the cover off. There is quite a collection of parts to scavenge inside one of these, and I especially noticed a stout power transformer, and numerous power transistors mounted on heat sinks. There were also four 6-volt gel cells in good shape (yes!).

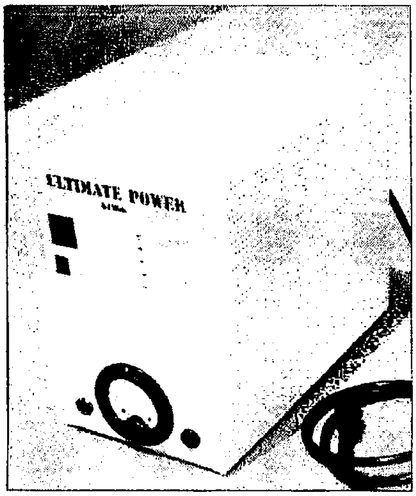


Photo A. The completed "Ultimate Power."

"The crowbar can save any equipment hooked up from destruction–especially your expensive radios!"

Inside the UPS

For those unfamiliar with UPS units, they are used to power critical electronics devices with 120-volt AC. If the commercial power fails, the UPS will provide power from batteries almost instantaneously. Usually they are used to provide short-term power for computers, providing power during an outage long enough for the computer to do a "clean" shutdown. This prevents "crashes" and data loss. Uninterruptible Power Supplies come in many sizes and shapes, depending upon current duty and battery size. Electronically, a UPS consists of a battery bank, a DC-to-AC inverter, and the sensing/switching circuitry. Some also "condition" the AC power, removing noise and RF, and also provide surge protection.

I looked up the numbers on the power transistors and found out they were N-channel power MOSFETs, with very good current handling specs. These transistors can be very useful, as they are high gain, low "on" resistance (less than 0.5 ohms), and you can parallel them directly without bulky current-balancing resistors. It turned out I had 16 of all the same type, already mounted on heat sinks.

I was intrigued by the large power transformer. In theory, the UPS takes low-voltage, high-current DC, switches it on and off to drive the transformer primary, and the secondary produces 120-volt AC. I wondered what voltage I would get if I reversed the transformer and powered it with 120-volt AC, so I tried it and got 14 volts AC (rms)! From the size of the secondary winding conductors I could see it would handle a lot of current.

A good estimate of the power handling capability of a power transformer can be found in the power supply chapter of the *ARRL Handbook*. Measure the central core of the transformer with a ruler and refer to the chart, which will give you a watt rating for the transformer.

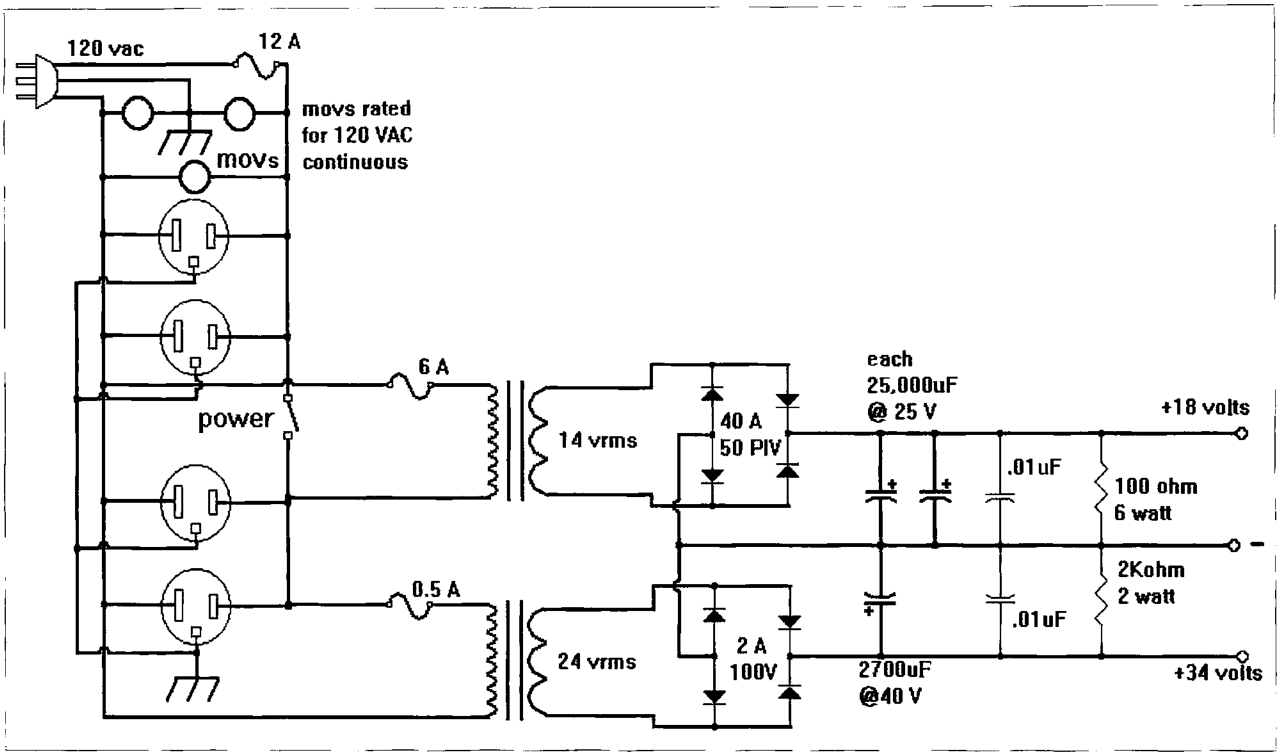


Fig. 1. "Ultimate Power" AC distribution/rectifier schematic.

Building the power supply

A UPS unit provides many of the components necessary to build a station power supply, all in one box. First, there is the box itself. If you've drooled over any parts catalogs lately, you know that a nice cabinet is expensive. Next is the power transformer, another expensive, hard-to-find item. Inside, there's a good supply of power transistors, already mounted and heatsinked. Lots of other miscellaneous parts can be used as well. I found diodes, filter capacitors, MOVs for lightning protection, and other goodies. Best of all, mounted on the rear of the cabinet are a string of AC outlets, so I set about building a "central power source" for my ham station, providing switched and unswitched AC, and 13.8 volts DC at 25 amperes.

I started with the 120 VAC side of the circuit, wiring some outlets "on" all the time and some switched. I added three MOVs across the AC input for surge protection. I fused the AC input and the two transformers separately for safety. After stripping the chassis of its dead "brain" board, I began the low-voltage circuitry. I fed the 14 VAC to a set of four 40 ampere stud mount diodes, mounted to the chassis sheet metal to dissipate heat. The diodes form a bridge rectifier, giving me 18.5 volts across the filter capacitors. I used some computer surplus filter caps; approximately 2000 µF per ampere is a good rule of thumb.

In designing the regulator, I came upon a dilemma. The MOSFET transistors would work excellently as pass devices to reduce the voltage to 13.8, but required +3 to +5 volts gate-source for turn-on. This meant that I couldn't use the same supply for the regulator drive. The other alternative is to use P-channel devices, but I had none. Luckily enough, there was another small transformer in the UPS used for charging the batteries and powering the "brain" board. It just happened to be a 24-volt transformer, so the small transformer powers the 723 regulator and the gates of the MOSFETs.

Referring to the regulator schematic, I used the ever-popular LM723 voltage regulator IC in a standard configuration. For best accuracy and minimum temperature drift, use precision 1% or 2% tolerance resistors for the sample voltage divider (the 680-ohm resistors). The high side of the divider should connect directly at the output connector, after any ammeter used, for best regulation. Use a good quality trimmer pot (250-ohm) and adjust for 13.8 volts. Make sure the pass transistors (the power MOSFETs) are adequately heat-sinked, as they may need to dissipate significant power, depending on the transformer you have. I bolted a chunk of fin stock to the UPS heat sink (heat-sink grease is a good idea) as extra insurance. Use heavy-gauge wire for high-current circuitry (#10 or #8 for 25 amperes), to and from the pass transistors and the negative return wiring.

The extras

One item that separates good power supplies from the cheapos is a crowbar circuit. I have been the unfortunate repairman of a repeater powered by a supply without one more than once, and it's definitely worth the few dollars as insurance. The crowbar circuit senses when the voltage goes too high (when you short out a pass transistor) and becomes a short circuit, blowing the fuse. The other cheap insurance policy, of course, is to have the proper size fuse! The

crowbar can save any equipment hooked up from destruction—especially your expensive radios! Hook up the crowbar circuit across the +13.8-volt output of your supply.

Other accents you may add to this project are an ammeter and some method of indicating output voltage. You may prefer analog meters, or some sort of digital meter or bar graph (the 3914 bar graph IC comes to mind). That's the fun of building things yourself—being creative and original.

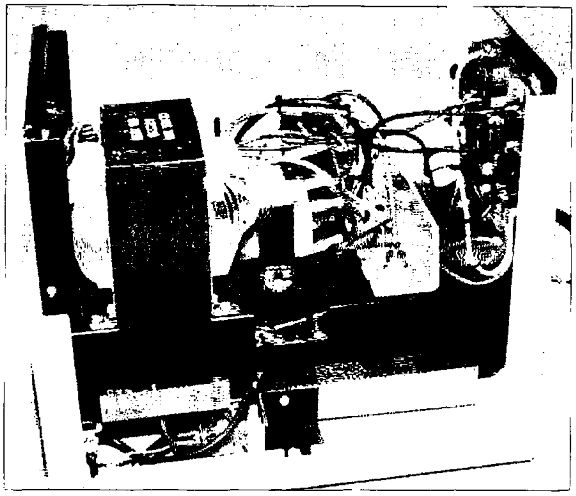


Photo B. Inside the "Ultimate Power."

How does it work?

Well, by now you want to hear how it performs. I stress-tested the supply by powering my 100 watt 2 meter FM amplifier with it. From 0 to 23 amperes, I measured less than .05 volts change in output, and less than 10 mV of ripple. The heat sink became only slightly warm after three minutes keydown.

The AC outlets allow me to power other station goodies from the same box.

All in all, I am very pleased with the performance. Credit goes to my eight-year-old son, Jeffrey, for giving me the idea to name it "Ultimate Power."

So, keep your eyes open for surplus UPS units—hamfests, auctions, or your friendly neighborhood computer geek—don't pass up a real home-brewer's bargain!

NEVER SAY DIE

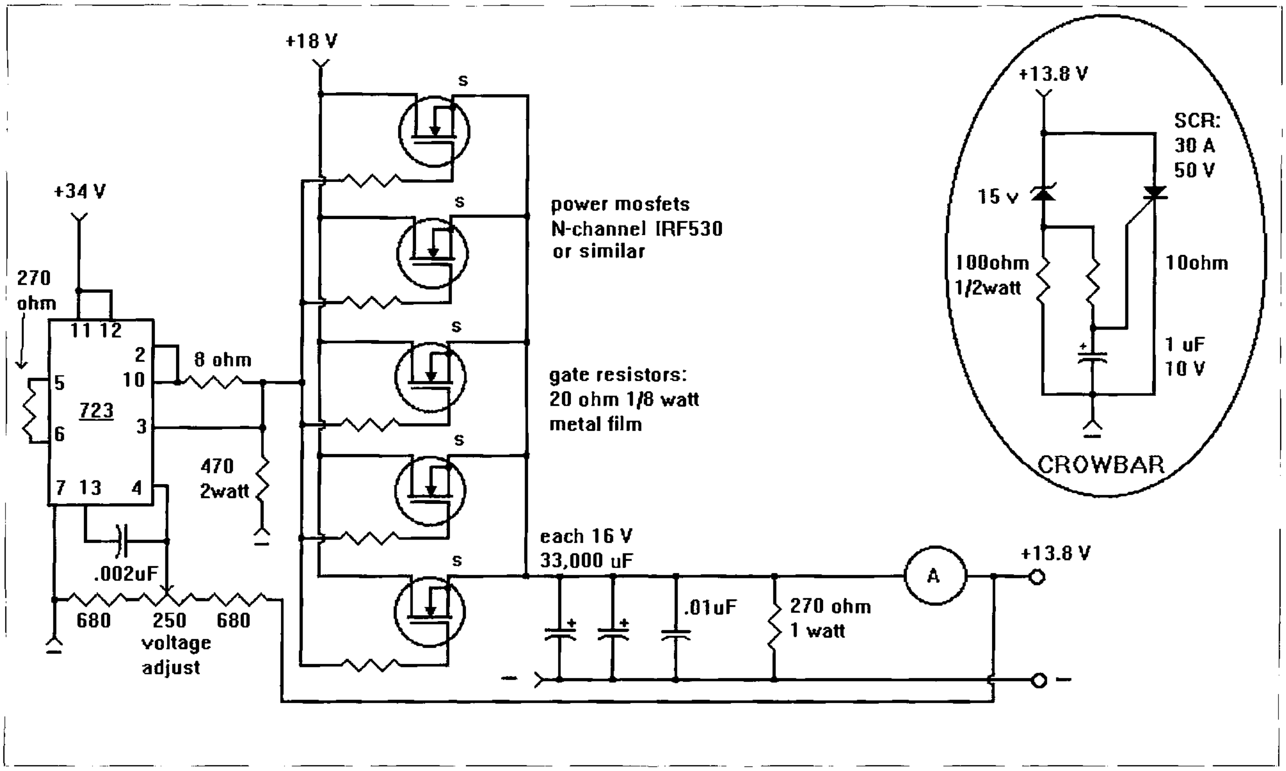
Continued from page 4

the stuff I sure wish I'd known years ago and am telling you about now is going in one eyeball and out the other, while you are foolishly depending on your doctor for your health as much as I was depending on mine. Well, the sad fact is that your doctor and mine don't know much about health. Doctors don't take any courses on health or its maintenance in medical school. Few are taught even one day about illness prevention or nutrition. The result is that doctors don't know a darned thing about health. They're taught how to make repairs when things finally break down and what sledge-hammer drugs to prescribe.

For instance, though it was considered totally crazy by the medical profession just a few years ago, now there's a grudging agreement that, yes, there's a (mumble) psychological component to every illness. But you aren't going to find any doctors anywhere who are making an effort to find these emotional triggers and treat them as well as the resulting physical symptoms. If it hurts, hey, take an aspirin, and never mind that the hurt is nature's warning signal that the body is in trouble. It's like the fuse in your rig. So, if the fuse blows, put in a bigger one, right?

Are you going to come bounding up to my table at the Dayton CompuVention in 2010, or will you be doddering with a walker to reminisce with me about how ham radio used to be before we lost our last two bands a couple years back?

Continued on page 49



Number 14 on your Feedback card

Colorado QRP Club's Field Day Operation

Field Day the hard way.

Marshall Emm AAØXI
2460 S. Moline Way
Aurora CO 80014

Who says the bands are dead? We are at or near the absolute bottom of the barrel in terms of solar activity and, hence, HF propagation. The bands are dead, so this should be an extended period of thinking, and building, and saving dollars to buy kilowatts, right? Wrong! Once again the Colorado QRP Club* has proven that you can do with skill, persistence, and antennas what others do with power, even when the bands are "dead."

Field Day is a trial at the best of times, and the constraints on site preparation and the logistics of manning a club operation are a challenge, but operating QRP really separates the sheep from the goats. CQC (Colorado QRP Club) has a core local membership of experienced and talented operators, who saw QRP operation in Field Day as, well, nothing out of the ordinary at all.

The results speak for themselves—close to 1200 QSOs for 10,000 points, all of them at 5 watts or less, and high ranking in the 2A Battery division, if not outright dominance. The formal results are not yet in as this is written, but the QRP grapevine functions very well. Once again, the CQC proved that if you can do it at all, the odds are pretty good you can do it QRP.

Of course, anyone with a ham license knows that power is probably the least productive of the factors that go into a QSO. We all had to learn the power equations that prove the difference between 5 watts and 100 watts is roughly two S-points at the receiving end—go to a kilowatt and you pick up another one and half S-points! To put it another way, the difference between a watt and a kilowatt is 30 dB, or five S-points.

QRP operators are also aware that losses are more critical at low power levels, so there is a lot of concentration on antenna efficiency. It follows that a large part of CQC's Field Day effort centered around the antenna farm, and what an antenna farm it proved to be!

Photo A. The 60-foot tower, ready for launching. FD Chairman KF7MD, right background, looks a bit anxious. Photos by ABØCD.

Remember, we started "planting" our farm on Friday afternoon. Despite the traditional Field Day thunderstorm, we got our crop in and here's what we were ready to harvest when the starting gun went off:

BAND	ANTENNA
ALL	G5RV @ 40'
160m	Sloper at 55' on the 60' tower
80m	2 element delta loop array, apex @ 65'
40m	3 element delta loop array, apex @ 55'
40m	Sloping dipole @ 60' on the high end
20m	3 element delta loop array apex @ 45'
20/15/10m	Tribander @ 45' w/ rotator
15m	Monobander @ 35' w/Armstrong rotator
6m	5 element @ 65' w/rotator
2m	11 element @ 65' w/rotator
6m/2m/70 cm	Beams for packet and Novice stations

Three (count 'em!) towers, and for most of us a much better selection of antennas than we enjoy at home!

We set up two HF stations with specific band and antenna assignments, as well as a separate VHF/UHF/packet station, and, of course, our Novices set up their own station (including the G5RV at 40 feet). We used computers for logging, and decided that we would forgo the all-emergency-power bonus for the sake of data security—it was our first real attempt to use computers and we didn't want to take any chances with power fluctuations or blackouts. We could have rented a generator, but the noise would have spoiled the peace and quiet of a superb site on a ridge about 50 miles southeast of Denver. A hundred feet of extension cord to a nearby house allowed us to power the computers and lights.

Operators were assigned in teams comprising an operator and a logger for each station, and the teams were rostered to cover the entire Field Day period, and we also had "site hosts," gofers, and even a chef. In fact, breakfast on Sunday morning was one of the highlights of the event.

Field Day is always a test of adaptability, and we had our share of problems to fix. Being forty miles from the nearest parts store or home QTH forces one to

be prepared, and to be flexible. There's always something you have to cobble together, and you tend to hear a lot of guys going around muttering, "It's not a contest. It's NOT a contest."

Operationally, everything went pretty much according to plan apart from an emergency rig replacement on Sunday morning. And I was a bit late for a 3 AM operating shift because a small-town policeman took exception to my velocity (but fortunately my ham license plates or my Field Day mission convinced him to write a warning rather than a ticket).

The delta loop arrays on 80, 40, and 20 were the real powerhouse antennas for HF, and we noticed an average 1-2 S-point improvement toward the east using the 3 element deltas. If you want to refer back to what I said about QRP power levels earlier, you'll see that switching antennas was as effective as going from 5 watts to 100! No activity was noted on 160m and very little on 10m CW, but for the most part we were as busy as the QRO stations.

Conditions? Well, "conditions" turned out to be pretty good, but I remain convinced that they depend as much on good antennas and operating skills as on solar phenomena. And it's surprising how often you can call CQ on a "dead band" and get an answer.

QRP operation does indeed engender skill, and knowing how to break a dogpile or the ability to copy a "1/1/9" signal can make a big difference. Probably the only significant operational difference is that it's often difficult to "hold" a frequency with a QRP signal, so we spent more time in search-and-pounce mode than calling CQ TEST. If we could hear them, we could work them. As usual, 20m phone was an alligator pit (all mouth and no ears).

It was definitely a successful Field Day, a real team effort and a credit to all who participated. But if there is one person who should be singled out, it's CQC's Field Day Chairman, Paul (KF7MD), who was responsible for planning and coordination, and kept it from falling apart. As we took down the towers on Sunday afternoon I saw him staring off into the distance and asked him what he was looking at. He replied, "I think we could run a V-beam down there next year!"

* For more information, drop us a line at: Colorado QRP Club, P.O. Box 371883, Denver CO 80237-1883. E-mail: CQC@aol.com (Subs: $10.00 US $12.00 foreign).

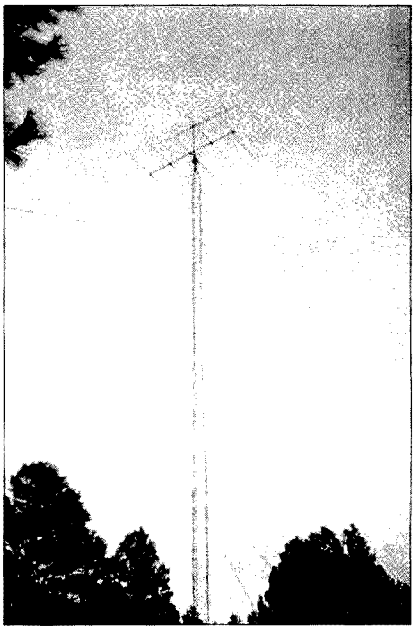


***Photo B.** "Now if we could just move this to my backyard on Monday...."*

Number 16 on your Feedback card

440 Yagi Link Antennas

Improve your repeater system by building new antennas for about $2 each!

Marty Gammel KAØNAN
1703 Hewitt Ave. West
St. Paul MN 55104-1128

Recently I was asked to make two pairs of link antennas for one of our local repeaters. The transmitter and receive sites were about three miles apart. The new receive sites were about eight and 10 miles from the transmitter, and only 3 watts of power was to be used between the links. (The old antennas had only three elements each, with a bad match.) Even white noise was present—not good for a repeater in the process of adding more receive sites, as well as a 6 meter input and output. So I had the task of coming up with better antennas to help improve the repeater system.

The new 434 MHz link antennas I came up with were each four elements. In accordance with good engineering standards, I chose to use different sized spacing between each of the elements for maximum forward gain on this point-to-point installation for repeater link use. I used simple gamma matches and old aluminum TV antenna booms. The new antennas worked perfectly, with a 1.1 to 1.2 SWR. They are full quieting; no more white noise on the system.

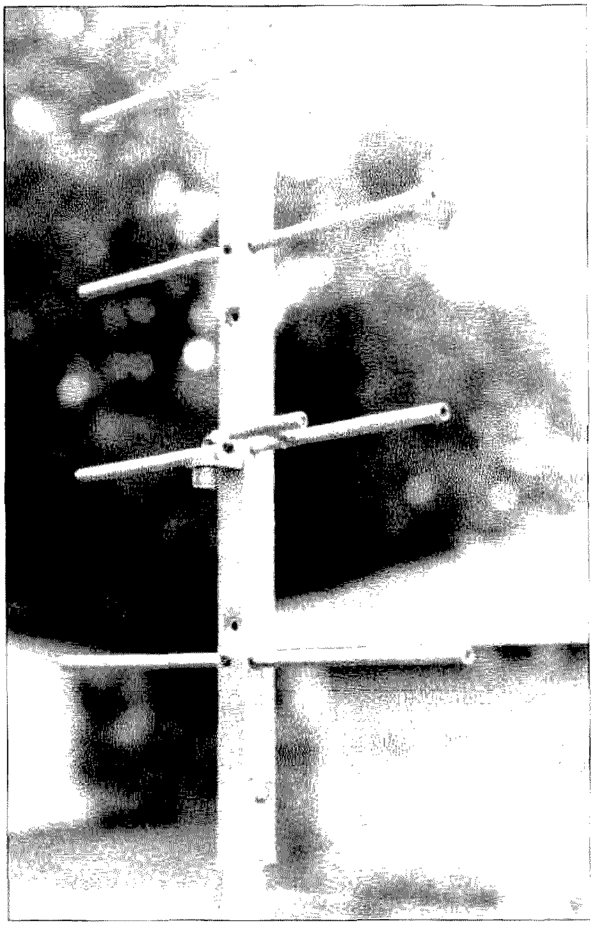


Photo A. One of KAØNAN's completed 440 yagi link antennas.

"My cost for each antenna was only a little over $2."

People are always giving me old TV antennas, so the only thing I had to go to the hardware store for was the stainless steel self-tapping screws. My junk box supplied the SO-239 fitting for the feed point, some RG-8 coax, some thin sheet aluminum for making gamma straps, and the SO-239 mounting bracket.

My cost for each antenna was a little over $2.

Building the antenna

I started by gathering together all the materials and tools needed to complete the project. First, I stripped the unwanted parts from the TV antenna boom. Usually, I drill out the rivets that attach the elements to the boom. Please remember to save all straight pieces of tubing for use in future VHF antenna projects (about the only things I throw away are the plastic element mounting pieces). If you don't have an old TV antenna to strip parts from, and you are having trouble finding 3/8" diameter aluminum tubing in your area, try your local scrap metal dealer or metals dealer. They usually sell this tubing by the pound.

Applying the formula

To determine the correct lengths for cutting your tubing for the target frequency, use the formula: 468 divided by the frequency times 12. This will

give you an answer in inches. This will give the length for the driven element; for the reflector, add 5%; and for each director, take off 2% to 3% from the driven element length.

Cutting the parts

With a hacksaw, cut a 18" to 20" piece of boom material for each antenna you are going to build. You can use a hacksaw to cut the pieces of tubing, but a tubing cutter, like plumbers use, will give a much smoother cut.

Cleaning everything

If the boom material is very corroded, you may want to use a Scotch-Brite™ pad or fine steel wool to clean it; clean the tubing for the elements while you are at it. The few minutes you spend cleaning the parts will give you a more professional-looking antenna.

Drilling the holes

Measure in 1/4" from the edge of the 1" square aluminum boom, and scribe a line for drilling the holes to mount the elements. I use a small bit first, drilling a 1/8" pilot hole for the 3/8" drill bit. Place the element holes so you have the right amount of space between each element (see **Fig. 1**).

Mounting the elements

Make a mark 1/2" each way from the center of each element, then push each element through so that you can see your marks. At this point, drill a 3/32" hole through the boom and element to secure each element permanently to the boom, using the 1" #6 screws.

Making the gamma match

I had some short pieces of 3/8" aluminum tubing in my junk box, and RG-8 coax is the perfect diameter coax to fit inside 3/8" tubing to make the gamma. Cut a strip of thin sheet aluminum or brass for the gamma strap; a piece 3/8" by 3-1/2" will make a suitable strap (if you don't have any in your junk box, you can get some at a hobby shop or craft store). Bend one end of the gamma strap around the gamma tube, using pliers to get a snug fit. You will want 1/2" of space between the gamma tube and the driven element to get the antenna to

"You can use a hacksaw, but a tubing cutter will give a much smoother cut."

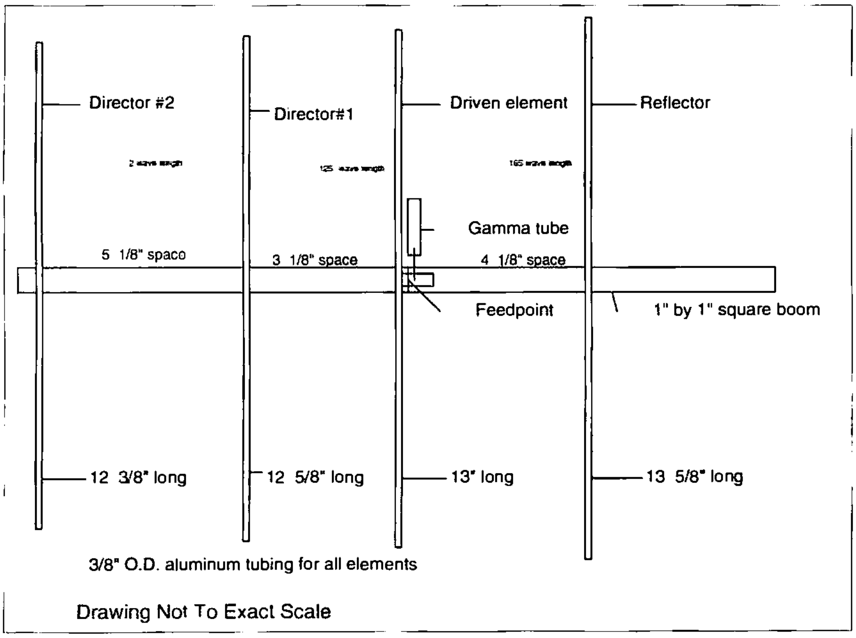


Fig. 1. Construction details.

load properly. Use the pliers again to bend the strap around the driven element to get a good snug fit. Drill a small hole through each end of the gamma strap as close to the tubing as possible, and install a small nut and bolt with a lock washer in each hole (see Photo A). Strip about 1/2" of the dielectric off one end of the RG-8 after the outer covering and the shield have been removed. Bend the stripped end of the RG-8 so that you can solder this end to the SO-239 fitting. Drill two small holes in the other end of the feed point mounting bracket, and attach this bracket to the boom with self-tapping sheet metal screws.

Making the feed point

While you still have the tin snips out, cut a piece about 7/8" by 2-1/2" for the feed point mounting bracket. Next, cut or drill a hole 1/2" in diameter to mount the SO-239 threaded fitting (this depends on the fitting you choose to use) near one end of the 7/8" by 2-1/2" feed point mounting bracket (look closely at **Photo A**).

Now compare your antenna to the one in the photo. Recheck all your measurements before proceeding with the tuning procedure.

Tuning the antenna

To check the SWR, I mounted the four-element yagi link antenna onto the end of a piece of tubing so that it pointed straight up, away from any nearby wires and objects. Then I slid the gamma strap along the driven element to find the best match. After that, I tried sliding the gamma tube in or out until I found the best SWR reading.

Anyone with questions about my antenna design may write to me at the address above. For a prompt reply, please enclose a #10 S.A.S.E. along with your questions.

Parts List
For <u>each</u> antenna:
Tools needed:
Hacksaw
Screwdriver
Pliers or wrenches
Drill bits
Tin snips or shears
Tape measure
Tubing cutter (optional)
Drill press (optional)
Scotch-Brite™ pad or fine steel wool

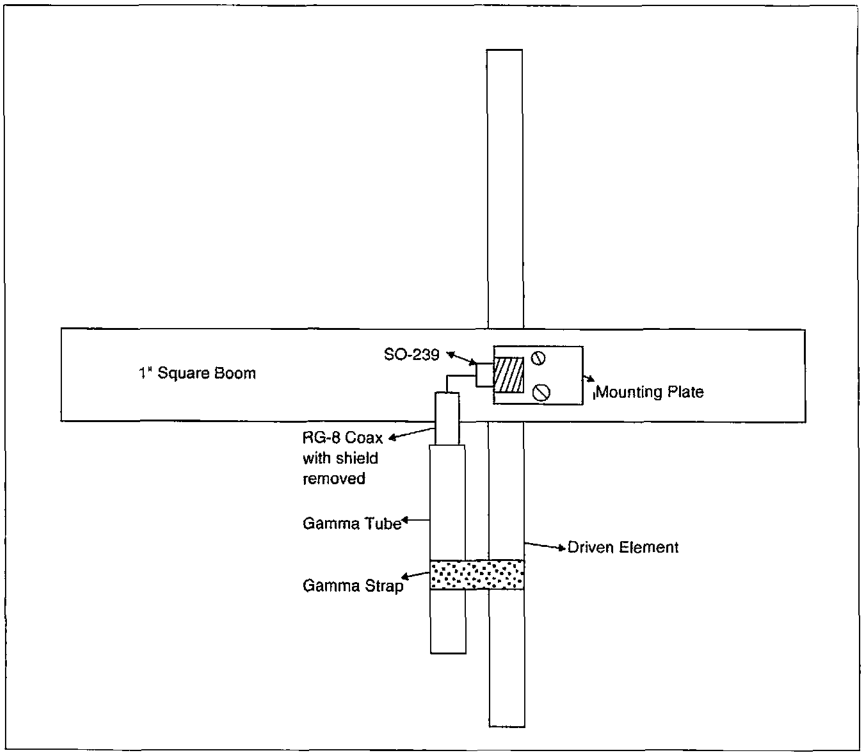


Fig. 2. Gamma detail.

A Versatile QRP Random-Wire Antenna Tuner

A quick way to tune up your QRP rig in the field.

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Salinas PR 00751-0030

When QRP rigs are taken on camping trips, you usually use an end-fed random-length wire tossed up into a tree for an antenna. To match the unknown impedance of the antenna, a tuner is necessary, and an SWR meter is needed to adjust the tuner.

An L-network is the circuit normally used to match the antenna to the rig. However, there are three possible L-network circuits, only one of which will produce a minimum SWR match with a particular length antenna wire and operating frequency, especially when modified by local conditions and structures in the vicinity such as wire fences, trees, and overhead wires. The height of the antenna, the conductivity of the ground, and Murphy's law can also complicate matters.

Usually, L-network tuners require input and output connections among three specific points in the L-network to be swapped around until the proper circuit configuration is discovered. This is not only tedious and time-consuming, it is also no longer necessary.

The tuner described here is designed so that once input and output connections are made, a twist of a knob allows the operator to select among the three possible circuit configurations, allowing rapid tune-up using whichever internal circuit provides the best match and lowest SWR, which equates to the lowest reflected power.

This tuner also includes a simple circuit which allows you to monitor reflected power. It does not require calibration because it is the minimum reflected power which indicates the best match possible between your transmitter and the particular antenna in use. Further, the reflected power meter sensitivity is made variable with a panel control so this tuner can be used equally well by QRP and QRP_p operators. The reflected power meter doesn't measure SWR: it only shows the point of best antenna matching.

For those of you who say, "But I want to *know* my SWR!" I offer the following facts:

1. The rationale for using any antenna tuner is to obtain the *best match possible* between the rig and the available antenna.
2. Minimum reflected power indicates the *lowest SWR possible* with the rig and antenna.
3. *Knowing* the exact standing-wave ratio at the lowest reflected power will not reduce the reflected power even a microwatt.

The point is that you don't have to know the actual SWR figure in order to get the optimum match between your transmitter and a given antenna.

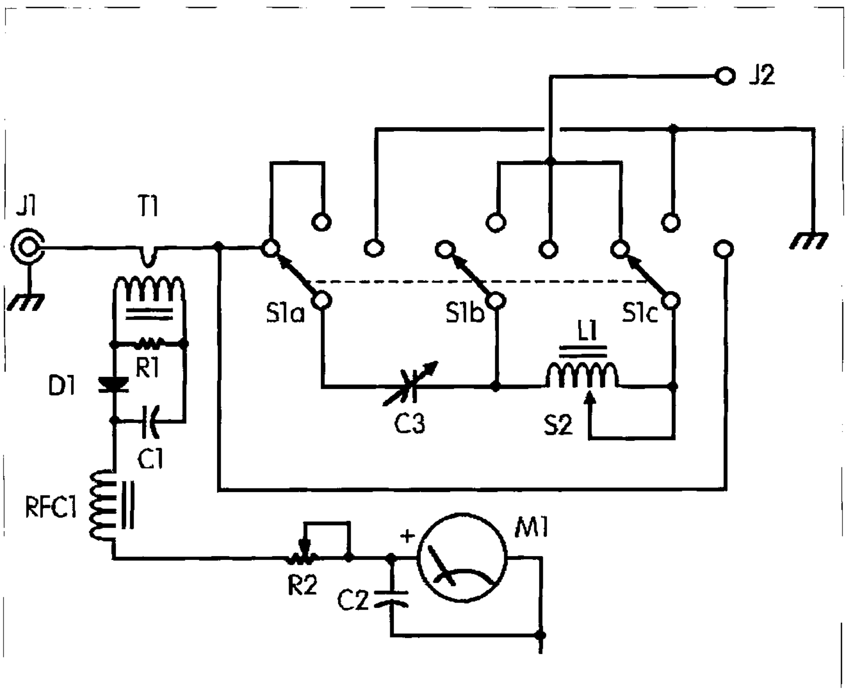


Fig. 1. Schematic diagram of the Random-Wire Tuner.

The circuit

Refer to **Figs. 1** and **2** for the following discussion. The heart of the circuit is the L-network, consisting of C3 and L1. Switch S1, a three-pole, three-position rotary switch, allows you to change the configuration of C3-L1 among each of the three basic circuits illustrated in **Fig. 2**. The numbers assigned to each circuit are the same as the positions of S1.

L1 is a tapped toroid with taps every two turns to allow the greatest flexibility in tuning. The taps are selected by S2, a one-pole, 12-position rotary switch. C3 is an air dielectric variable capacitor. Both capacity and inductance are controlled by knobs on the front panel.

RF applied at J1 flows through the primary of T1 to the L-network selected by S1, then to the antenna at J2.

The voltage developed in the secondary of T1 is rectified, filtered, and applied through sensitivity control R2 to meter M1. R2 allows you to keep the meter needle on scale while adjusting C3 and L1 to obtain the best match, indicated by the minimum dip of the needle on M1.

Construction

Although this tuner will function equally well if built on a breadboard, it's best to construct it in an enclosure so it will not be damaged when jammed into a backpack. I recommend using an aluminum box, or one made of blank printed circuit board material.

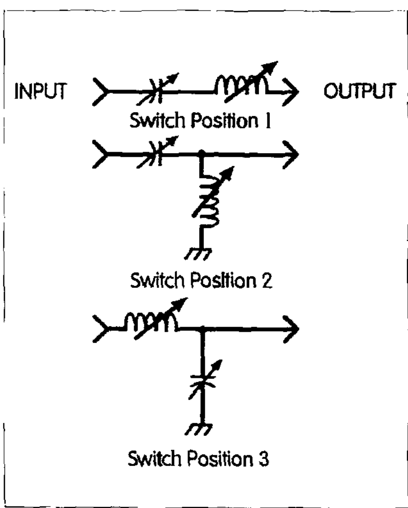


Fig. 2. L-network circuits.

C3 *must* have both rotor and stator insulated from ground! If possible, use an insulated shaft coupler and a short piece of 1/4" rod through the panel; the control knob can be affixed to this rod later.

You can make an insulated shaft coupler from a short length of 1/2"-diameter Plexiglas™ or Lucite™ rod, available from hobby and model shops (see **Fig. 3**). Drill a 1/4"-diameter hole lengthwise through the center (use a slow speed so the drill bit does not melt the plastic!). Then drill and tap setscrew holes through one side of the rod to accept 6-32 screws to secure the shaft of C3 and the short rod extending through the panel. Taking apart a defunct potentiometer will supply both a short piece of 1/4" shaft and a panel bearing.

To prepare T1, wind six spaced turns of AWG-22 wire on an FT37-43 ferrite toroid core. Space the turns evenly to cover about 70% of the core. Leave an inch or so of wire at each end for later connection. Coat the winding with liquid polystyrene, such as General Cement Q-Dope®. Allow it to dry for several hours, then add a second coat and allow that to dry.

L1 must be wound with 24 turns of AWG-24 wire on an FT50-43 ferrite toroid core, tapping it every two turns. Taps can be formed most easily while winding, by forming a loop about an inch long and twisting the wires together. See **Fig. 4**. These twisted loops will be cut, stripped, tinned, and soldered directly to the terminals of S2 later.

After winding L1, check to see that you have a twisted loop tap every two turns. There should be exactly 11 taps, with two turns of the main winding at each end. Then coat the winding with liquid polystyrene as detailed for T1, making certain not more than 1/4 inch of the twisted taps are covered where they leave the surface of the core.

Using a small piece of perf board, mount and connect the following components: T1 (mount upright with the bare core portion on the perf board and secure with a bit of epoxy or hot glue), R1, C1, D1, and RFC1. Connect a short piece of insulated wire to the junction between R1, C1, and the ground end of T1, and leave the other end free. Connect another short piece of insulated wire to the bottom end of RFC1 and leave the other end free. These two wires will be connected later. Set this assembly aside.

Prepare the panel and cabinet as desired, with the proper holes for C3, S1, S2, R2, and M1. Lead lengths are not important but should be made as short and direct as possible when wiring later.

Since the capacitor you will use for C3 is unknown, you will have to make certain it is mounted so it will be *insulated* from ground, as well as lined up so its shaft is directly in line with the panel hole for its control.

Connect jumpers between the proper terminals of S1 as shown in **Fig. 1**. Solder insulated wires a few inches long to each of the wiper contacts of S1a, S1b, and S1c. Leave the other ends free. Now mount S1 on the panel.

Mount the following components: J1, J2, R2, and M1. Solder a length of wire between J2 and the point indicated in **Fig. 1** on S1. Double-check to make sure that you have connected this wire to the proper point on either S1b or S1c, which are jumpered together.

Secure the insulated coupler to the shaft of C3. Mount C3 on its insulated mount and make certain its shaft is lined up exactly with the matching hole in the panel. If you install the panel bearing in this panel hole and insert the short length of shaft through the bearing, it must insert easily into the insulated shaft coupling before tightening the mounting of C3. With an ohmmeter make sure that both the rotor and the stator of C3 are not grounded. Tighten the setscrew on the short shaft extending through the panel, making sure it is not pushed so far into the insulated shaft coupling that it shorts the rotor of C3. Place a knob on this shaft and rotate C3 through its range. It should rotate smoothly without binding. Correct any misalignment until it rotates freely.

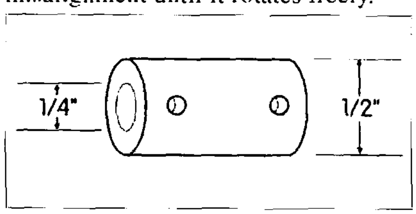


Fig. 3. Home-brew insulated shaft coupler.

When L1 is dry, clip the loops of each tap at its outer end. Strip the enamel off both wires of each tap, twist them together, and tin them with solder. Leave them long; they will be trimmed later.

Bend each tap so it is perpendicular to the flat surface of the toroid. Refer to **Fig. 5**, which shows the proper connection of L1 to S2, with the switch terminals assigned numbers. Carefully slip the taps, and the end of L1 connected to terminal 1, into the switch terminals. Use care so each tap enters its assigned switch terminal.

Snug L1 to within about 1/4" of the rear of S2, which will support L1. Solder taps 2 through 12 only. Clip off the long ends of the tap wires extending through the switch terminals.

Connect a short length of wire between the wiper terminal of S2 and terminal 1. Solder the wiper terminal only. Mount the S2-L1 assembly on the panel.

Route the free end of the wire connected to the wiper terminal of S1c and connect it to S2, terminal 1, then solder. Clip off any excess wire. Locate the loose end of L1 near tap 12 and route it to the wiper terminal of S1b, then solder it. Connect the free end of the wire connected to the S1b wiper terminal to *either* the rotor or stator terminal of C3, then solder. Clip out excess wire.

Connect the free end of the wire from wiper terminal 1 of S1a to the remaining unused terminal of C3, then solder. There is a jumper already installed between terminal 3 (clockwise, looking from shaft end) of S1a to terminal 2 of S1c. Connect a wire from either terminal to ground and solder both connections.

Mount the perf board assembly previously wired so a wire from the center connection of J1 can pass directly through the center hole of T1; this will form the primary winding. Solder a wire to the center conductor of J2, route this wire through the center of T1, then solder it to S1a, terminal 1 or 2, which are already jumpered together.

Connect the wire leading from RFC1 to terminal 3 (clockwise looking from the shaft end) of R2, and solder. Strip about half an inch of insulation from a short length of wire and feed this bare end through the remaining two terminals of R2, and solder both terminals. Connect the other end of this wire to the positive terminal of M1. Connect C2 between both terminals of M1. Connect a short length of wire to the negative terminal of M1 and solder both terminals of M1. Connect the free end of the wire from the negative terminal of M1 to ground.

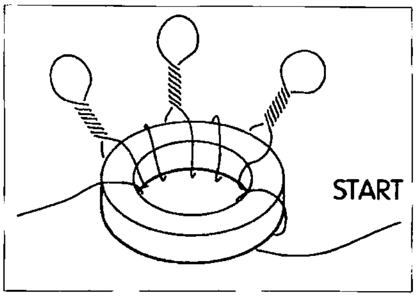


Fig. 4. Winding L1 with taps (partial).

Check all solder connections and compare your wiring to the schematic in **Fig. 1**. Repair any errors and double-check to make certain that both terminals of C3 are insulated from ground *only* with S1 in position 1, furthest counterclockwise. One terminal of C3 connects to ground through L1 at S1 position 2, and directly at S1 position 3.

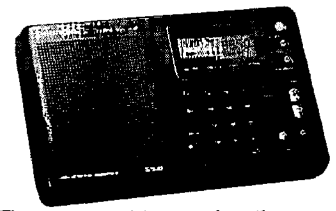
Operation

Connect the output of your QRP transmitter to J1 and an end-fed wire antenna to J2. Rotate R2 fully counterclockwise (maximum resistance). Set C3 at mid-range and S2 at position 6.

Key the transmitter and adjust R2 for an indication of reflected power on M1. Switch S1 back and forth, watching M1 for any dip, however slight. Leave S1 where the dip occurred, and adjust C3 and S2 for the deepest dip, adjusting R2 clockwise a bit as the meter needle falls.

Although this is probably the best match, leave R2 where it is after noting the position of the needle on M1, and try adjusting C3 and S2 with S1 at each of the remaining positions. If either position of S1 provides a *deeper* dip—less reflected power—than that first obtained, this is the correct S1 position for the best obtainable match.

It should be possible, adjusting the tuner as just described, to get the reflected power indicated by M1 at or



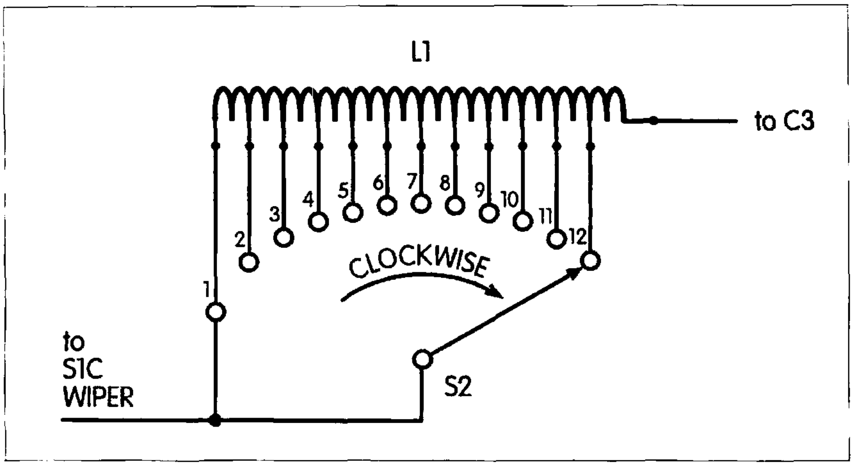


Fig. 5. S2-L1 connections, expanded rear view.

very near zero, even with R2 fully clockwise (minimum—zero—resistance). You may or may not achieve an exact 1:1 SWR—no reflected power—but properly adjusted, this tuner can achieve less than 1.5:1 SWR with just about any combination of transmitter, antenna and frequency over the HF bands, and usually *much* less than that.

It may be impossible, because of the simplicity of the reflected power circuit and the RF inside the tuner, to achieve a zero reflected power indication on M1, especially with R2 set for maximum sensitivity—no multiplier resistance in series with M1. Normally, there would be a fixed resistor in series with R2, or R2 would be a set-and-forget trimpot establishing the maximum reflected power at full scale of M1 in a calibrated circuit. However, I purposely made this circuit to have the maximum sensitivity possible, controlled by the operator, so the reflected power circuit would produce meaningful results when operating in the milliwatt range.

Regardless of the above, when you have achieved tuning which provides the deepest dip on M1, this is the *best match* you can achieve with the antenna and frequency in use. When you have achieved the deepest dip you can, adjust R2 to place the meter needle on any convenient scale marking. Then as you operate, especially if you change frequency by very much, check the position of the needle. If it has risen higher, a slight tweaking of C3 will usually return it to its previous setting.

A few hints

Some operators stick a long nail into the earth to ground their outdoor stations. Others use a wire counterpoise in addition to an earth ground, or instead of one. Properly chosen, a counterpoise will work very well, as long as *it is not a multiple of a half wavelength at the operating frequency.* A half wavelength or multiple thereof of wire, open at the far end, places a very high impedance at your station ground point, the exact opposite of the low impedance necessary. A counterpoise a quarter wavelength or an odd multiple thereof in length and open at the far end is also an impedance transformer, but in this case it inverts the high impedance at its open end to a very low impedance at the station ground post, exactly what is desired. However, when changing bands, make sure your quarter-wave counterpoise is not a half wave long on the new band!

If you use a monoband rig, carry a quarter-wavelength counterpoise for that band, regardless of the length of your random wire antenna.

If yours is a multiband rig, prepare a quarter-wavelength counterpoise for *each* band. Connect them together at one end and attach to your station's ground post. This way you will always have the correct length counterpoise as you hop from band to band.

Rather than using separate wires to make the multiple counterpoise, consider using a length of indoor telephone wiring cable which contains four, six or eight separate wires. Cut it to the length needed for the lowest frequency band. Choose the number of wires needed—one for each band—and connect them together to a spade lug or similar which will connect to your station ground. With a pocket knife or X-Acto® knife, make a slit a quarter wavelength from the ground post end in the outer insulation, clip one wire, and remove the unwanted portion of this wire from the other end of the cable. Do this for each band for which you need a counterpoise. Now you have a neat insulated cable which contains all the counterpoises your multiband rig will need in the wild. This cable will be equally useful at the home station, especially if you live above the ground floor or your ground connection is fairly long. 73

Parts List

C1, C2	0.01 µF disc ceramic
C3	Variable capacitor, 300 pF to 400 pF maximum
D1	Germanium diode (1N34, 1N60, 1N90, 1N270, etc.)
J1	RF connector, builder's choice
J2	Insulated binding post
L1	24 turns AWG-26 on FT50-43 core, tap every two turns
M1	100 or 200 µA DC meter
R1	51 Ω S% 1/2W carbon resistor
R2	25k Ω linear taper potentiometer
RFC1	1 mH miniature RF choke
Toroid	FT50-43 (L1)
T1	6 turns AWG-22 on FT37-4 core (see text)
S1	3P3T rotary switch
S2	Single pole 12-position rotary switch

Operating RS-12

It's easy!

Luis F. Orozco N5UHB/XE2MXU
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Monterrey NL 64949
Mexico

Whenever someone mentions satellite communications, we tend to think about expensive rigs and complex antennas. Fortunately, there is one satellite out there for those who don't have a "satellite station," or who just want to get started in satellite communications. The minimum equipment required to use RS-12 is an HF radio capable of operating "split" on 10 and 15 meters, and a 10/15 meter dipole. This means that most people who use HF already have all they need to get on the air with RS-12!

How do I do it?

RS-12 was launched on February 5, 1991, and it orbits the earth at an altitude of about 1,000 kilometers. You probably won't work any "long haul" DX (maybe in a few years!), but you should have no problem making cross-country contacts (see **Fig. 1**).

Presently, RS-12 operates in Mode K. The uplink frequency is from 21.210 to 21.250, and the downlink from 29.410 to 29.450. The ideal setup to work this bird would be to have two different radios with two different antennas. However,

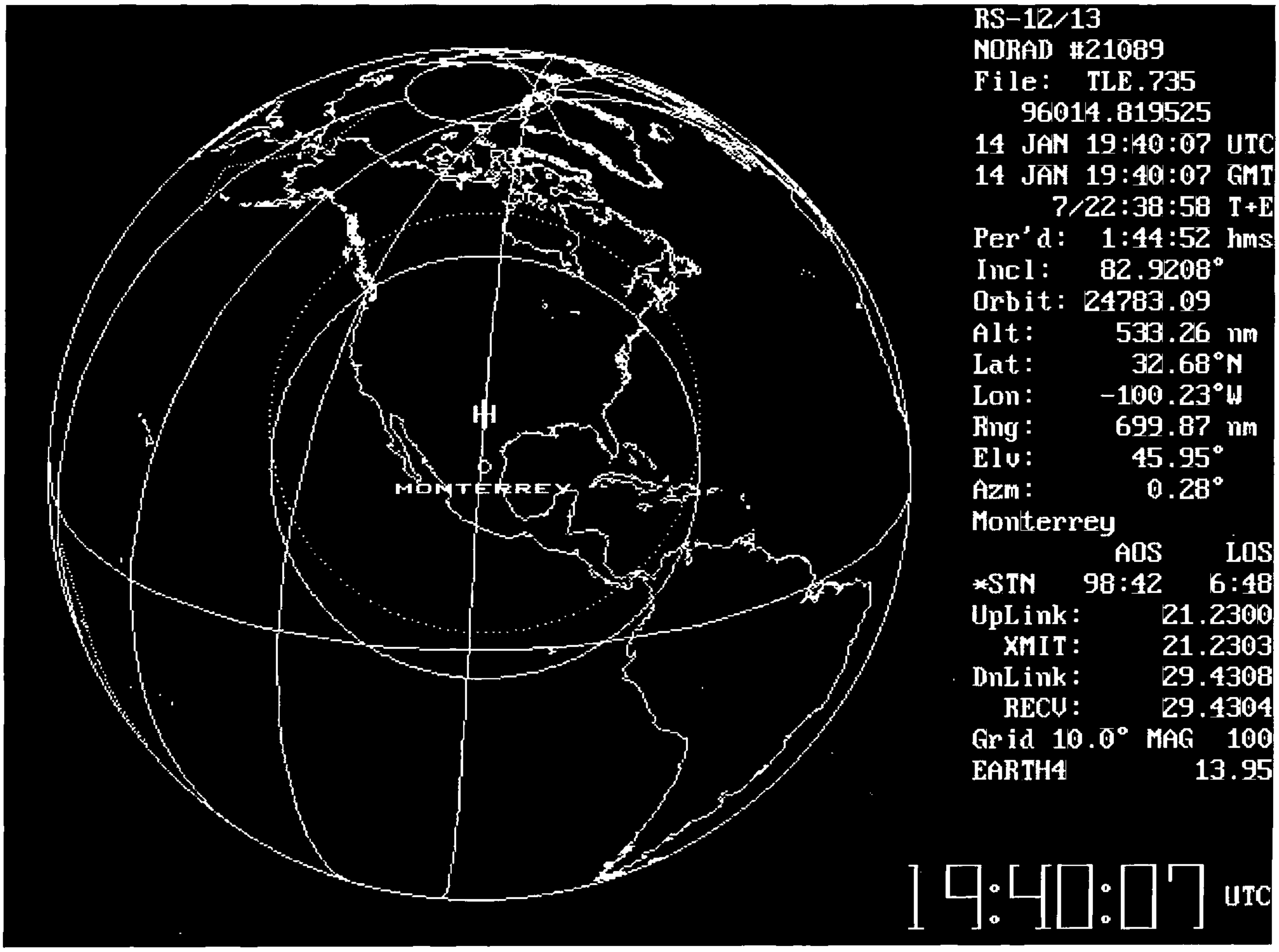

Fig. 1. Screen dump from STSPLUS's orthographic projection showing RS-12 passing over northern Mexico and the central US.

most hams have just one HF radio, which is fine as long as it has two VFOs. You still have the choice of what kind of antenna configuration to use. You could use just a 15 meter dipole since you won't be doing any transmitting on 10 meters. However, if you want to pull all the weak signals out of the noise, I would recommend making a dipole for each band and feeding them with the same coax. The antenna height is not very important here, as long as it has a somewhat clear view of the horizon (well, as clear as you can practically get without buying a new tower).

In order to know when the satellite will pass over your QTH you will need a satellite tracking program. There are quite a few of them out there, but I would recommend using STSORBIT PLUS, by David Ransom. Besides having great graphics, it is very accurate and fairly easy to use. If you have Internet access you can get the latest version at http://www.ozemail.com.au/~dcottle/. **Fig. 1** is a screen dump of STSORBIT PLUS's orthographic projection. If you don't have Internet access, find a local ham who does and ask him to get the program for you.

"Besides having great graphics, STSORBIT PLUS is very accurate and fairly easy to use."

In order to make accurate predictions with STSPLUS, or any other tracking program, you will also need Keplerian elements. These are a specially formatted set of numbers that specify the location of the satellite at a particular time. You simply plug them into the tracking program and let it do the number crunching. Files with Keplerian elements for all amateur satellites (plus many, many other satellites!) are also available at the above address. Keplerian elements are also distributed through packet bulletins, so you don't need Internet access to get them.

Getting to work

Now that you have all the gear set, you need to know how to use the satellite. This is fairly simple, and you should have no problems working anyone you hear after a little practice. First, put your radio in "split" mode and set the transmit frequency to 21.230. Your signal should be "coming out" on 29.430 (plus or minus the Doppler shift; more on this later). From there you can move up or down to whatever frequency you want (within the satellite's passband, of course). Since this satellite has a linear transponder, if you move your uplink up by 1 kHz you should also move your downlink up 1 kHz.

One final thing that you should take into account is the Doppler shift, which is caused by the satellite's motion. If you're using STSPLUS ORBIT, enable the Doppler shift prediction feature using the F8 key while the map is displayed. If your program doesn't have a Doppler shift feature, you can operate by trial and error. First choose an uplink frequency and tune your receive VFO to your corresponding downlink frequency, without taking into account the Doppler shift. Then make a call, and start tuning around your downlink. When using RS-12, the Doppler shift can be up to about 2 kHz, so tune 2 kHz up and down from the initial frequency until you hear someone answering your call. As the satellite goes by the Doppler shift will change, so you will need to continually readjust your receive frequency. You should also make sure you are not transmitting on top of someone else.

Finally, a word about power: Don't run the linear when 100 watts will do the job just fine. And don't run 100 watts when 10 watts will do it! If too many people get on the satellite and are using too much power, signals will start to fade and it will be a lot harder to work other stations.

Working satellites is a lot of fun, and RS-12 is the perfect bird for those of us just starting out. See you on the air! 73

A Multiband Trap Dipole Antenna System

This easily-constructed HF antenna system is a perfect combo for use with portable rigs.

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Rockford MI 49341

It's been said, "there's nothing new under the sun," and so it is with this antenna system—its basic design dates back more than 40 years. What's unique about this antenna, however, is that it's a complete system, including a matching unit that I've found ideal for use with the newer compact HF rigs that do not include a built-in tuner (Kenwood's TS-50, ICOM's IC-706, etc.). And it's easy to build using components and parts which you should be able to locate at your local hardware store and/or in your junk box.

Trap dipoles

I've built several trap dipole antennas over the years, but the design that's worked best for me is that originally described by C. L. Buchanan and subsequently modified by Arthur Greenberg a number of years ago (see Bibliography). It used a single pair of traps resonating somewhere around 7.2 MHz to give "five-band" coverage, and this basic design, or some modification of it, has been carried for many years in various handbooks and antenna manuals. I've further modified this original design to use coaxial-cable traps in place of the open-wound inductor style originally used, to make the antenna a bit more rugged. **Photo A** shows the construction details of the traps I currently use.

While the original traps worked fine, but turned out to be high-maintenance items. No matter how well I tried to shield them, water invariably found its way in. Also, the originals, having a somewhat larger diameter, were good wind-catchers, which caused the antenna to come down a lot—usually resulting in something getting broken, like one of the ceramic capacitors. This type of capacitor has proved to be somewhat hard to find, and is usually expensive when you *do* find one. Since changing to coaxial cable traps, I've had a version of this antenna up for several years without having any of these problems.

"A multi-tapped coil, selector switch, variable capacitor, and a couple of coax connectors are all the components needed to build this L network."

Most trap dipole antennas represent a compromise over a full-length antenna, either in terms of bandwidth or performance, or both. This antenna by itself really worked satisfactorily on 40 meters and on a portion of the 80/75 meter band. Operation on other bands and/or full 80/75 meter coverage really requires the use of some type of matching unit. Previous rigs I've used having internal tuners worked fine, generally managing to load the antenna even on WARC bands. Since acquiring a TS-50, I needed some kind of external matching unit in order to use this antenna effectively, but I didn't want to use some big, bulky, or expensive tuner—thus the L network. **Photo B** is a picture of the L network matching unit I came up with.

L networks

L networks have been used as effective matching devices for a number of years. Their popularity fell off some during the heyday of TVI, however, because an L network's attenuation of harmonics or other spurious signals is not as good as that of a Pi or T network. From a simplicity standpoint, though, an "L" is hard to beat. Also, newer rigs typically use well-designed bandpass filters that do an excellent job preventing radiation of harmonic signals, making this shortcoming somewhat less of a concern.

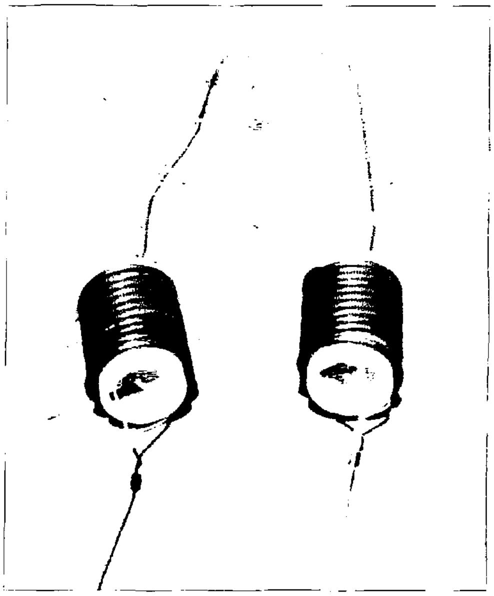

Photo A. Coaxial cable trap construction details.

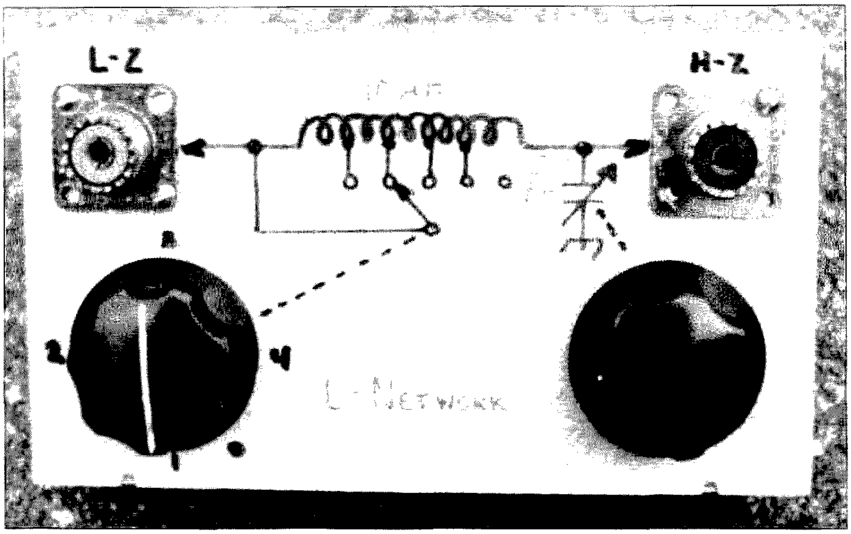

Photo B. The L network matching device.

The unit I use is small (see **Photo B**), measuring just 2" x 3" x 5", so it works quite nicely for portable operation. L networks can be arranged in a series/shunt (or shunt/series) fashion using capacitor-capacitor, inductor-inductor, or inductor-capacitor arrangements. The configuration I used has a series inductor with a shunt capacitor (see **Fig. 1**). This style permits matching low impedances to high when connected normally, and high to low when reverse-connected. L networks are bidirectional in terms of input and output, which makes them extremely useful in a variety of matching applications.

While originally intended for use with my trap dipole, I've since found this L network to be generally useful in both portable and mobile operation. It does a good job, for example, in matching my TS-50 to a variety of antennas, including random wire types and a mobile whip. If I can't find a match with it connected one way, I simply reverse it and try again. However, 75 meter mobile operation does require use of an additional base loading coil.

Building the L network

As shown in **Photo C**, a multi-tapped coil, selector switch, variable capacitor, and a couple of coax connectors are all the components needed to build this L network. It's built in a mini-box enclosure similar to one available from Radio Shack (#270-238, which is 5-1/4" x 3" x 2-1/8"), and wired as shown in **Fig. 1**.

The inductor used was made from an available section of mini-ductor stock, but a custom-wound coil can be made using a 3" piece of 3/4" PVC tubing as a form. It should be 23 turns of #16 or #18 wire, spaced to fill the 3" form to give approximately 10 µH inductance. (Some brands of PVC tubing are more suitable than others for RF applications. A quick test can be made by heating a sample section in your microwave for 15 to 30 seconds. If the sample appears to have warmed appreciably, I'd recommend trying another brand. I'd also suggest using some technique other than touching the sample to determine if it has been warmed by the microwave—the wrong stuff could be *very hot!*)

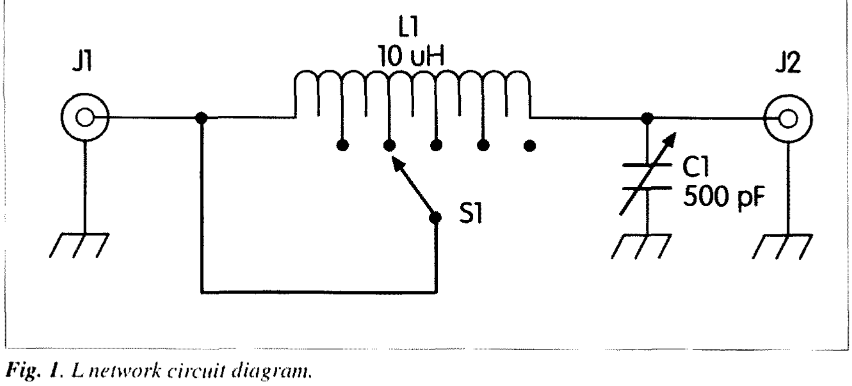

Fig. 1. L network circuit diagram.

For my matching network, a five-position ceramic switch was used to select five tap points on the coil. The tap points were distributed evenly along the coil every four to five turns to match the switch positions. A switch with more positions would be better, as finer inductance steps could be selected, but this one was available from the junk box. A suitable substitute would be the 12-position switch sold by Radio Shack™ (#275-1385). Using a switch like this would require tapping the coil about every second turn, but would give great incremental resolution.

The capacitor used is an old broadcast replacement type having a maximum capacity of around 500 pF. Capacitors like this are getting harder to find but show up frequently at hamfests. Should your junk box fail you, Antique Electronic Supply of Tempe AZ carries a capacitor similar to the one used here, as well as others, as standard catalog items.

"I've found this system ideal for use with the newer compact HF rigs that do not include a built-in tuner."

Another viable option for the required shunt capacitor would be using the 12-position switch previously mentioned to select a series of 50 pF fixed capacitors. This switch is a shorting type which would make wiring something like this fairly easy. Should you try this option, I would suggest selecting capacitors with 500-volt or higher ratings.

Constructing the antenna and traps

My original five-band antenna's traps used a pair of 5 µH inductors shunted with 100 pF capacitors. Since the overall length of a trap dipole is largely governed by the inductive component of the trap coils, I wanted to get as close to the original design parameters as possible because I didn't want to alter the antenna's size significantly (at just over

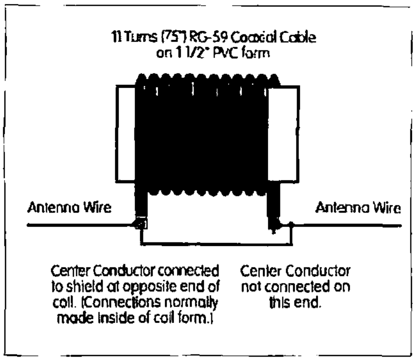

Fig. 2. A) Coax-cable trap circuit.

100 feet overall length, it fits nicely in the space I have available for it). With this objective and a desire to build traps with reasonable "Q," I chose RG-59 foam cable which has about 17 pF per foot as a good compromise for my new traps.

The traps are wound on a 1-1/2"-diameter by 4-1/2"-long PVC pipe forms which have a 2" outside diameter. I ended up using 75" of cable per trap in 11 close-wound turns to resonate near 7.15 MHz. This works out to approximately 100 pF and 5 µH, which is very close to the original design values and doesn't significantly affect my overall antenna length (or performance). **Fig. 2a** shows the trap circuit, and the construction details are shown in **Fig. 2b**.

After winding the cable on the forms, I drilled termination holes for the cable and wired the shield from one end of the coax to the center conductor of the other end, as shown in **Fig. 2a**. I then drilled two 1/8" holes, directly across from each other, at each end of the PVC form and ran some bare #12 wire through to form connecting points to tie the traps to the antenna wire. Finally, after soldering all connections, I sealed the coax cable ends with RTV sealant, coating everything completely to ensure that no water would get into the cable. **Photo A** shows details of the completed traps.

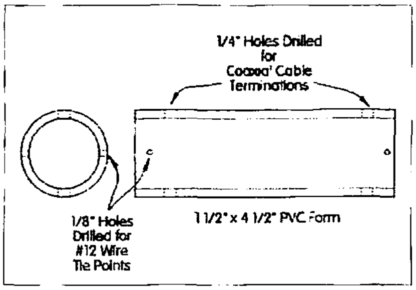

Fig. 2. B) Trap construction details.

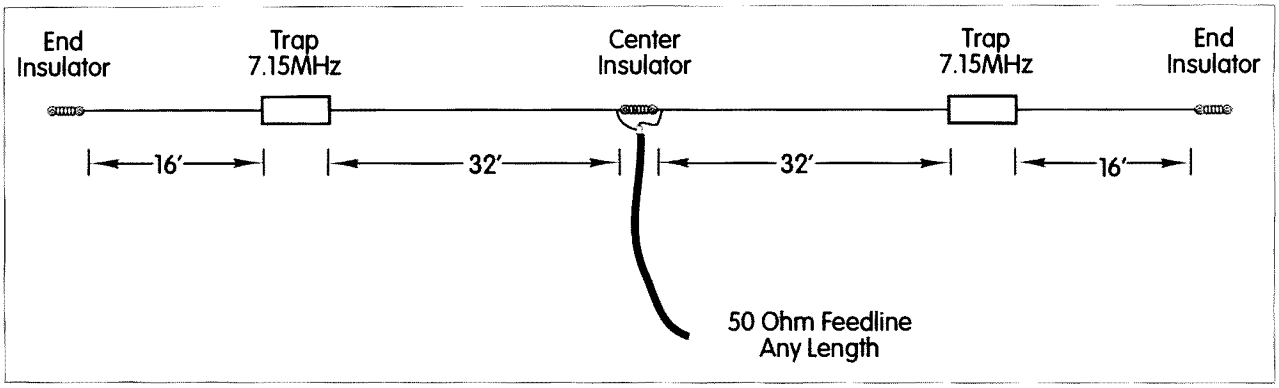

Fig. 3. Trap dipole construction details.

I originally intended to run egg insulators through the centers of my traps to provide strain relief, but I never got around to it. So far, the 1/8" holes in the PVC forms have not pulled out, and the antenna is still up, but using some type of strain relief is a good idea.

The antenna wire was attached to the traps using the dimensions shown in **Fig. 3**. I used #12 electrical wire with the insulation left on for the actual antenna wire. I typically buy Romex™ cable and strip it down to recover the individual wires. This stuff is cheap and makes good antenna wire.

I'm currently using RG-8 cable to feed the antenna, but I have used RG-58 or RG-59 (70-ohm) in the past with equally good results. In fact, the 70-ohm stuff is probably a better choice for this antenna, especially when using it with an L network matching device.

Tuning and operating

If this antenna is built using the dimensions shown and used with the L network described, no further antenna tuning should be necessary. Should you want to fine-tune it a bit, the 32' lengths (see **Fig. 3**) could be adjusted for resonance at 7.2 MHz or so, and the 16' lengths adjusted for your favorite part of the 80/75 meter band. If you have access to a grid-dip meter, you might also want to check the traps for resonance. However, I've built several sets of these traps and have found that when using 75" lengths of RG-59 cable (Radio Shack #278-1319), they always resonate where expected.

Having a built-in SWR indicator would probably facilitate adjusting the L network since my TS-50 does not include this metering function. I initially used an in-line meter with it until I became familiar with its operation. Now, I simply tune it for maximum output power as indicated by my TS-50's meter (relying on its SWR protection power cut-back circuitry). I generally use the 50-watt power level when tuning in order to offer some protection to the transceiver.

As previously mentioned, I've had this antenna and matching system for a few years now, and its performance has been excellent. I have on occasion had a full-length 80 meter dipole up, and in most instances my signal reports have been as good or better with this antenna system whenever I've made comparison tests. 73

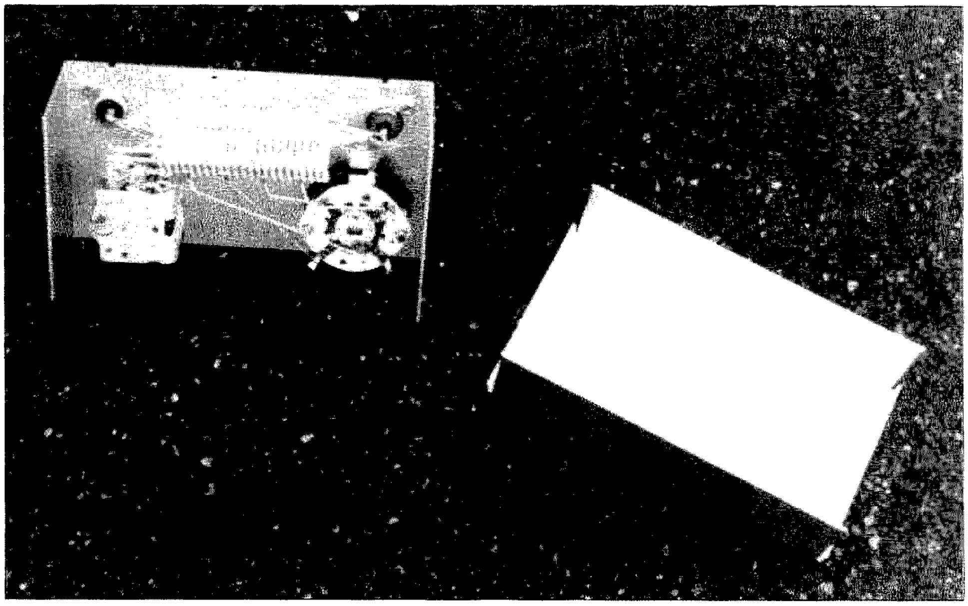

Photo C. L network construction details.

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Buchanan, C. L., "The Multimatch Antenna System," *QST*, March 1955.

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Hall, Gerald, et. al., *The ARRL Antenna Book*, ARRL (Newington, CT, 1988); Chapter 25: "Coupling the Transmitter to the Line."

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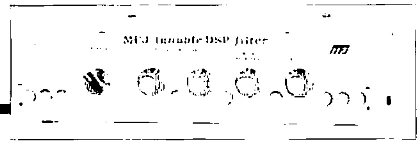
Pattison, B., "A Graphical Look at the L Network," *QST*, March 1979.

Number 30 on your Feedback card

73 Review

The MFJ Tunable DSP Filter

So little noise, you might think you're the only one out there.



Jeff M. Gold AC4HF
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Cookeville TN 38501

If you can't hear 'em, you can't work 'em, so your receiver has to be able to separate the noise and signals. Sometimes the unwanted noise appears in the form of adjacent signals, especially during contests. There have been considerable advances in using computer technology to help you zero in on the signal you want and get rid of other signals and noise. Many new transceivers come equipped with Digital Signal Processing (DSP).

What are the rest of us to do? You add a good DSP unit to your existing rig. MFJ's 784B is a tunable DSP filter that has many functions. It is a 16-bit machine that runs at a 12 MHz clock speed. This allows the DSP to interpret the incoming data very rapidly and decide what is information and what is noise.

This unit has so many noise fighting features that the manual is more like a textbook. The good news is that there is an easy-to-follow section in the beginning of the manual that allows you to get up and running right away. I work with computers for a living, so I hate to read manuals when I get home. I unpacked the MFJ filter and wanted to get it on the air in about ten minutes. I chose to use the quick start suggestions and had it in line in a very short time. You will find that to take advantage of many of the features, you *will* need to read the manual. It is reasonable to expect to put in 8-10 hours to really master all the functions of this filter.

The MFJ DSP unit is made to work with SSB, CW, AM, packet, AMTOR, PACTOR, RTTY, SSTV, WeFAX, FAC, weak signal VHF, EME, and satellite modes. The filter has fifteen pre-set filters for these modes. Five of these filter settings are locked in. You can customize filter settings using ten programmable filters. The custom settings allow you to save desired center frequency/bandwidth, low pass/high pass cutoffs, auto/manual notch, noise reduction or other settings. You can select a pre-set filter and then kick in some of the other noise-fighting features to meet the current band conditions.

The unit goes in between your transceiver/receiver and an external speaker or headphones. It uses 12 VDC or you can buy the MFJ-1315 ($14.95) adapter. The unit comes with MFJ's one-year "No Matter What" guarantee. They will repair or replace the unit for one year, no matter what you've done to it. The filter lists for $249.95, and it's an experimenter's dream. If you like to fiddle with knobs and buttons, this unit will keep you busy for quite some time.

"It's excellent for contesting because it allows you to get rid of overlapping signals."

General features

•5 factory pre-set filters
•10 programmable pre-set filters
•Tunable spotting tone—works even in narrowest CW filter position
•Adaptive tuning—center frequency tuning automatically becomes finer as you narrow the bandwidth; makes it easier to use very narrow filters
•Automatic notch—can vary aggressiveness
•2-1/2 watt audio output
•Ability to turn speaker off and use phones, or use both phones and speaker
•Reporting of active filtering (uses Morse code)
•Automatic filter bypass during transmit to monitor CW sidetone, voice or data
•Manual notch in CW mode
•Noise reduction, automatic notch and tunable notch can be used in memory mode
•Mark-Space frequency and baud rates for data modes
•Adjustable line level output
•Self-testing for all digital circuitry, switches and controls

Automatic notch filter

This filter is designed to find and eliminate unwanted heterodynes very rapidly. CW and RTTY signals can also be eliminated. The filter is extremely narrow, yet doesn't degrade voice signals. This filter is also useful for getting rid of unwanted tuner-uppers (a favorite pastime of a number of operators on 20 meters). In addition to the automatic notch, there are two manually tunable notch filters. These can be effective for separating out a CW station you want to talk to from other unwanted CW stations. On SSB the DSP did the best job when set at the least aggressive setting.

Adaptive noise reduction

This filter gets rid of background noise. In many instances during noisy band conditions, it can make the difference between picking a signal out of the noise or not. The noise reduction mode works with all the other filter modes and will work on random noise, white noise, static, ignition noise and power line noise. The filter gives up to 20 dB of noise reduction.

Tunable high-pass/low-pass filters

These filters work for both voice and data. The lower cutoff frequency can be tuned from 200-2200 Hz and the upper cutoff frequency from 1400-3400 Hz.

You can tune out unwanted signals very close by. This is an effective filter for SSB contesting because it allows you to get rid of overlapping signals. I found this filtering ability to be excellent. On shortwave listening it helps kill heterodynes from stations 5-10 kHz away.

Tunable bandpass filters

These filters work well with narrow band signals such as CW and RTTY. You can tune the center frequency from 300-3400 Hz and then vary the bandwidth from 30 Hz-2100 Hz, which gives you very sharp CW filtering (good for contesting), and wider sharp RTTY, etc. filtering. By narrowing the bandwidth you can eliminate signals that are 60 Hz away. The filters don't appear to have much problem with ringing; I used them quite a lot on CW.

Comments

One important factor with the DSP unit is to set the input level correctly. The procedure for doing so is quite clear in the manual. If you start to use the DSP and think it isn't working right, you most likely have the level set incorrectly. In most cases the pre-set filter settings did what I needed to operate in almost any type of band condition. In the two months I tested it, the unit did everything the other DSP units I have used did and a whole lot more.

The one area where this filter really excelled was when using it with the digital modes. "Out of the box, the pre-set digital modes sounded like a commercial tape. That unit works the digital modes like nothing I have ever used," Conard WS4S commented. Using the double bandpass (dbp) filter capability you can set separate Mark and Space frequencies and really get rid of unwanted signals.

I tested the filter on a Yaesu 757GXII, a Ten-Tec Argosy II, and a Kenwood 930S. Conard WS4S summed up the testing in these words: "You can get real lonely using this filter. You can crank up the filters to the point where you think there's no one else on the band. Then before depression sets in you take the filter out of line and realize that you are not alone."

For more information, see your dealer or contact MFJ Enterprises, Inc., Box 494, Mississippi State MS 39762. Phone (601) 323-5869 or FAX (601) 323-6551.

Number 32 on your Feedback card

Build the FOX Controller

A sneaky device to make foxhunting even more fun.

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Staten Island NY 10302

Once upon a time, the Staten Island Amateur Radio Association (SIARA) held a foxhunt in the Great Kills Park on Staten Island to test the DF units several club members had made. George (The Bear) NA2V volunteered to be the fox. He hid in the woods and periodically transmitted on his HT. We took bearings to determine his location, but we didn't locate him very quickly because we were getting many false nulls that were probably due to multipath.

I can still hear George growling that he had outfoxed us. Rich KB2OH finally located him. After the foxhunt was over we discussed how we might improve our direction-finding technique. Sy AA2RT asked if the transmitter could be operated automatically. Sure, with an automatic ID unit. I set out to build one.

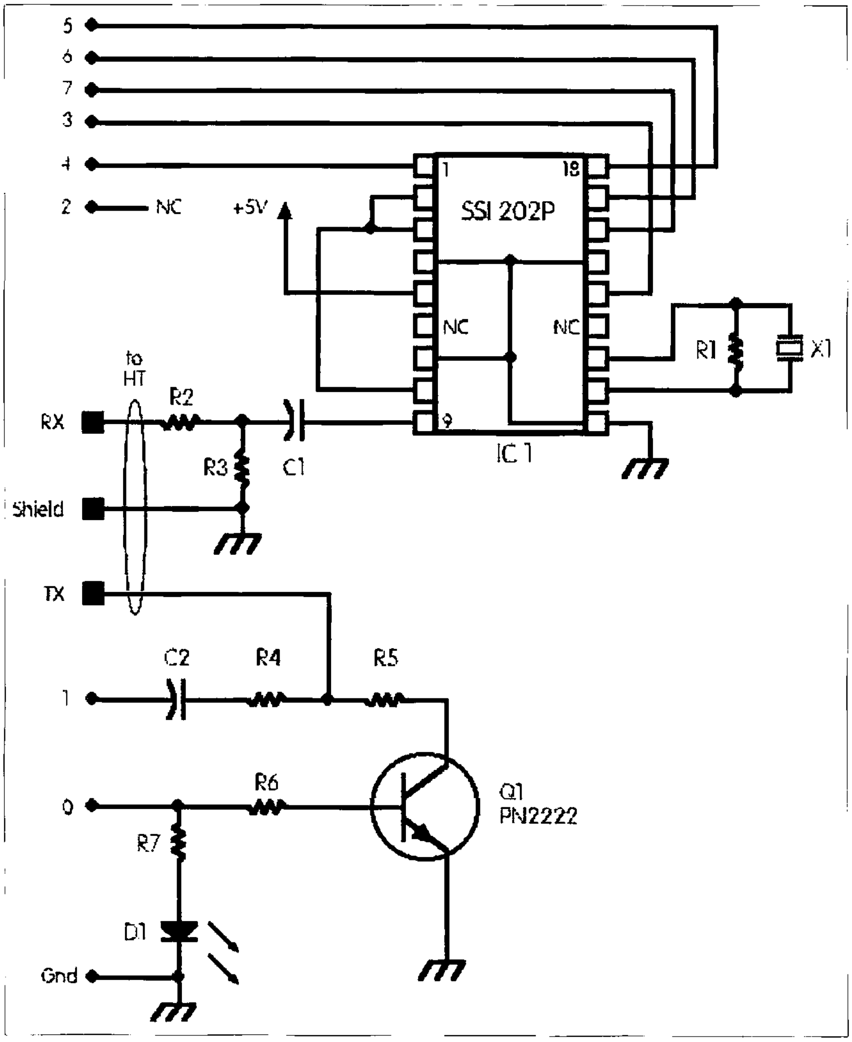

Fig. 1. Circuit for the FOX Controller. *Numbered terminals indicate connections to BASIC Stamp module.*

The BASIC Stamp

Through *73* I have learned about control circuits using devices like the 555 timer, counters, gates, and a diode matrix (a type of ROM) to serve as a controller and ID unit for experimental beacons and repeaters. Then I read about a new toy that I just had to get, Parallax Inc.'s BASIC Stamp, so I ordered one complete with the development system, from Digikey. Application Note #8, "Sending Messages in Morse Code," provided a flash of inspiration, so I adapted this program to suit my foxy needs.

The BASIC Stamp is a really neat 9V battery-powered computer/controller about the size of a large postage stamp, hence the name. It has eight I/O lines and 256 bytes of memory that can be programmed in the BASIC language using a PC development system. The BASIC Stamp board has a small prototyping area that can be used for adding custom circuitry. I used this area for a DTMF decoder and the PTT keying and audio coupling components. The FOX controller decodes DTMF commands received on a separate receiver, and keys the foxhunt transmitter accordingly. This provides for wireless remote control that can be very handy during a foxhunt. Alternately, the FOX controller can receive commands on the fox's own receiver.

Construction

You should be able to build this project for under $50 if you have any kind of a junk box. There are three different versions of the BASIC Stamp. I used the original discrete component version, which has a removable 93LC56 EEPROM and PIC16C56 BASIC interpreter IC. There are newer SMD versions that allow for a more compact assembly, but these versions do not have

```
'Program FOX.BAS version 7 for text rev 2 3/27/96 by R. Johansen WB2SRF
adapted from Parallax Inc. application note # 8
'Improve DTMF Noise Immunity
' When dtmf * is received the FOX activates the transmitter carrier
'then a high beep tone then a low beep tone carrier drops for 5 sec.
' When dtmf # is received for 5 seconds after low beep operation is cancelled
'signals OK to check operation
' When dtmf 0 is received unit sends Hi Hi (laughter)
'This program applies PTT, five tones, pauses 4.5 minutes then sends the ID.
'The five tones are generated 200 mSec apart useful for determination
' of either Tx or Rx delay.

Symbol Tone= 100
Symbol Quiet = 0
Symbol Dit_length = 7 'Change these constants to
Symbol Dah_length = 21 ' change speed. Maintain ratios
Symbol Wrd_length = 42 ' 3:1 (dah:dit) and 7:1 (wrd:dit)
Symbol Character = b0
Symbol Index1 = b6
Symbol Index2 = b2
Symbol Elements = b4
DIRS=%00000111 'define input/output pins

'pin 0= PTT pin 1= sound output pins 3-7 dtmf input


DTMF:
pause 50
b8=pins/16 'sets up pins 4-7 for binary input
if pin3=0 then dtmf
rem debug#$B8 'displays dtmf in hexadecimal form
If B8=$0A then HIT
IF B8=$0C OR B8=$0B then OK
goto dtmf


OK:
pause 2000
if pin3=1 then OK 'strobe loop to holdoff ok
high 0
pause 500
for index1= 0 to 1
lookup index1,(227,163),Character
gosub morse
next
low 0
if B8=$0C then dtmf
pause 1000


Identify:

high 0 'Holds PTT
Sound 1,(110,20,105,20,100,20,95,20,90,20) 'Tones to evaluate PTT delay

for b10 = 0 to 17 ' 18 beeps x15.5sec = approx. 4 minutes 39 sec
high 0
pause 500
sound 1, (110,10)
```

Listing continued on page 34

Listing continued from page 33

```
pause 10000
sound 1, (90,10)
low 0
pause 5000
if pin3=1 then dtmf
next

high 0
pause 5000

' send the word WB2SRF/fox in morse

for Index1 = 0 to 9  'change for number of characters
lookup  Index1, (99,132,61,3,67,36,149,36,227,148) , Character
gosub Morse
next
low 0
goto dtmf

HIT:
pause 2000
if pin3=1 then hit ' loop to holdoff hit
high 0
pause 1000
for index1= 0 to 3
lookup index1, (4,2,4,2), character
gosub morse
next
low 0
goto dtmf


Morse:
let elements = Character & %00000111
if elements = 7 then adjust1
if elements = 6 then adjust2
Bang_key:
for index2 = 1 to elements
if character >=128 then dah
goto dit
Reenter:
let Character = Character * 2
next
gosub char_sp
return
adjust1:
elements = 6
goto Bang_key

adjust2:
Character = Character & %11111011
goto Bang_key
end

Dit:

sound 1, (Tone, Dit_length)

sound 1, (Quiet,dit_length)
goto Reenter
```

Listing continued on page 35

a removable EEPROM (see note in Parts List).

Install and wire the DTMF decoder, PTT keying transistor and audio coupling components into the prototyping area (see **Fig 1**). I used #30 insulated wire-wrap wire as jumpers soldered between the connections. A three-pin header was used to make the connections to the HT's audio, PTT, and ground. I put the HT and controller inside a surplus ammo box equipped with a BNC antenna connector and it was all set.

Operation

Once you've built your foxy controller you'll need two HTs to transmit and receive on the same frequency. You'll probably want to offset the frequency of the fox's receiver or use the tone decoder mode of your HT so that only you can control the fox. Sneaky, huh ? The FOX controller can also listen for commands on one band (UHF) and control the fox on another (VHF).

Set your HT's volume control to the middle of its range and attach the plugs from the controller. The controller then listens for a DTMF command to start the operation. When a "*" is received the PTT line is enabled, "OK" is transmitted in Morse code, a high-pitched beep is emitted, followed by 10 seconds of carrier, then a low-pitched audio beep, then the carrier drops five seconds before resuming. This lets you know that you've contacted the FOX controller, and that it's about to key up for 4.5 minutes. If a "#" or "0" is sent at this time the operation is canceled. After 4.5 minutes it sends an ID message (WB2SRF/FOX in my unit) before releasing the carrier.

When a "#" is received, the unit will test the operation without going through the long sequence above. The PTT line is enabled, "OK" is sent, and the carrier is released.

When a "0" is received, the unit will transmit "HI HI" and then silence the transmitter (this is for when you feel someone is getting too close). Of course, when using a single HT as both the fox and the FOX controller receiver, you need to wait until the 4.5 minute timer expires before sending additional commands.

Use the lowest output power setting of the fox HT to conserve battery life and make it more difficult to find.

What next?

The BASIC Stamp/DTMF decoder combination can be used for all kinds of things. For instance, I intend to write software for selective calling and a DTMF display using a LCD panel. The EEPROM can be overwritten or removed and replaced with one loaded with different programs to suit different applications. What applications can *you* think of for this neat hardware? 73

Acknowledgment: Thanks to Chantal and Jim at Parallax for giving me permission to use and adapt Application Note #8.

Footnotes:

See *QST*, May 1993 pg. 35, "Build the Handifinder," by Bob Leskovec K8DTS.

See *73 Amateur Radio Today*, June 1994, pg. 46, "The Morse Messenger," by Scott Edwards.

See also *Nuts & Volts* magazine, May 1994, pg. 35, "Counterfeit Stamp Development System," also by Scott Edwards, a good tutorial on how the BASIC Stamp works.

The following sources will offer you a free catalog upon your request:

Parallax Inc., (916) 624-8333
Digikey Corporation, (800) DIGIKEY
JDR Microdevices, (408) 494-1400
BG Micro, (800) 276-2206
Scott Edwards Electronics, (602) 459-4802

Listing continued from page 34

```
Dah:

sound 1, (Tone, Dah_length)

sound 1, (Quiet,dit_length)
goto Reenter
Char_sp:
sound 1, (Quiet, Dah_length)
return

Word_sp:
sound 1, (Quiet, Wrd_length)
return
```

Parts List

X1	3.579545 MHz crystal, 17pF load capacitance
C1, C2	.01µF 50V ceramic capacitors (2)
R1	1M 1/4W resistor
R4	100k 1/4W resistor
R2	4.7k 1/4W resistor
R3, R5, R7	1k 1/4W resistors (3)
R6	10k 1/4W resistor
Q1	PN2222
D1	Red LED indicator

Miscellaneous

20" lengths of RG-174 or miniature audio coaxial cable (2)

Mini phone plug "receiver audio (earphone) output"

Submini phone plug "transmitter audio (mike) input"

3-pin header plug and socket part of 929974-01-36-ND and PZC36SAAN from Digikey

18-pin IC socket

Digikey #STAMP-ND kit (includes one Basic Stamp); use with your own PC to program your own functions: also available from Parallax (includes blank EEPROM socketed 8-pin dip)

SSI202P DTMF decoder

Note: If you do not wish to purchase the Development Kit to program the BASIC Stamp a programmed EEPROM for the discrete component version is available from the author, at the address above, for $10 postpaid (US delivery). Some hard-to-find parts such as the SSI202P and completed units may be available; contact the author for price and availability.

Number 36 on your Feedback card

A 30m Through 80m Loop

Great indoor antenna for QRP.

Jay Jeffery WV8R
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The reasons for designing a relatively small antenna for 80 meters are usually to get around antenna restrictions or to solve the problem of lack of space. There is another good reason, however, and that is convenience.

Consider an antenna that fits easily into a room of a house, is easy to build and repair even during the worst weather, and is simple to tune. Isn't that convenience? The difficult thing is coming up with one that's small but capable, even at QRP levels of power (5 watts or less).

The design

Having had good QRP results on 40 meters with a small, single-turn loop based on standard designs, I decided to try to scale it up to 80 meters. Using proportions, I estimated the size needed and laid it out on the dining room floor using ordinary zipcord and a 250 pF variable. I was lucky and was able to tune up on 80 meters the first try. By pruning it, I was able to use the full extent of the capacitor. I found that I could tune the 30 and 40 meter bands, as well as the 80. I also found that the loop, though technically a small loop, was not exactly tiny. It was approximately 64 inches square.

Since the antenna was to stand upright to save space, I made it 66.5 inches high and 62.5 inches wide. This favors the vertical wires, which do most of the radiating. Two advantages of having the loop upright are that it is less sensitive to being near ground level than a horizontal loop, and it has some gain along the plane of the loop. Also, interference can be reduced because of the sharp tuning characteristics of a small loop and by means of the null associated with this type of antenna.

> ***"This antenna fits easily inside a house, is easy to build and repair even during the worst weather, and is simple to tune."***

Since my house is constructed of wood, the antenna works well in almost any location; some homes or buildings have a lot of metal in their construction that could shield the antenna and cause it to work poorly. Even so, there may be a spot that will work, such as a porch or an attic space above the metal.

One drawback of an antenna in the home is the danger of an RF burn. Insulation of the exposed parts of the antenna can help prevent this, but an indoor antenna must be treated with respect when it is being used to transmit.

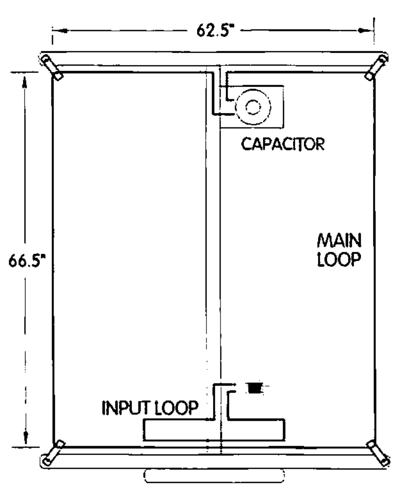


Fig. 1. The 80 meter loop antenna, showing the construction details.

Construction

Insulated house wire (#12 stranded) was used to form the loop. However, a wire loop requires a frame to hold it. I built a simple frame of furring strips designed to put as little wood between the radiating wires as possible. The frame holds the loop, the variable capacitor (240 pF), and the coupling loop firmly in place, yet it is lightweight and easy to reposition. See **Fig. 1.**

The sides of the loop are separate pieces of wire, supported and connected with plastic terminal blocks (Radio Shack™ #274-678). Since bolts and screws hold the frame together and the wire sides are held by the terminal block screws, it is easy to disassemble the whole antenna to move it. The capacitor is mounted on a Plexiglas™ plate screwed to the central support. (A plastic enclosure would be safer, but the plate was quicker.) The actual construction took about two hours.

Looking at the circuit design in **Fig. 2**, you can see the small loop that couples the coax to the main loop. The coupling loop is made of solid insulated #12 wire. This makes it more rigid for easy shaping and positioning. The top of this loop is held by part of a

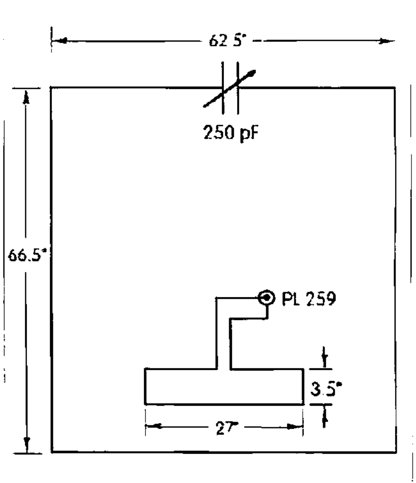


Fig. 2. Loop antenna circuit design and dimensions.

terminal block. The bottom is taped to the main loop itself. The small loop is 27 inches by 3.5 inches.

Operation

The antenna must be tuned to the frequency to be used, by connecting the antenna to a transceiver set for the desired frequency. Turn the knob on the capacitor until resonance is reached. At this point the background noise or signals will be heard, and they will be at a maximum. If the frequency is clear of traffic you can transmit briefly at low power to peak the output, using a field-strength meter. Marking resonance points on the plate that holds the capacitor makes retuning very quick and simple.

By inserting a tuner and an SWR meter in the circuit, the impedance seen by the transmitter can be improved and a wider range of frequencies can be used without retuning the antenna. Only the tuner needs to be touched up if the changes in frequency are not drastic. Recording tuner settings for future use will allow you to leave the tuner in the circuit, set it, and then resonate the loop.

Using an antenna analyzer, the resonance can be found more quickly and accurately without having to transmit.

The antenna sends out maximum signals along the plane of the loop. At the same time there is a pronounced null perpendicular to the plane at its center. These properties can be employed to enhance received and transmitted signals. Also, aiming the null at a noise source can cut down or eliminate that noise. I keep the antenna flat against a wall in an upstairs bedroom. By moving the left side or the right side out, I can easily change direction.

Since this antenna was intended for QRP use, or as much as 10 or 15 watts, the capacitor from an old 300-watt tuner served the purpose. At greater power levels a capacitor with a higher breakdown voltage should be used. Also, much more care should be given to safety considerations.

Comments

It's a pleasure to operate CW or SSB QRP on 80 meters using a relatively small antenna while still getting very good results (not getting TVI complaints is also pleasant, even when the TV is in the next room). The antenna works as well on 30 and 40 meters as it does on 80. Give it a try.

Desoldering

Damage control for the PC board.

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

A lot of paper has been run through the world's printing presses describing how to solder electronic components onto a circuit board. Now, I'm going to tell you how to *unsolder* those same components.

The process of removing solder from a PC board can be as basic as reheating a connection or as advanced as using surface-mount hot air desoldering equipment. Surface-mount parts are not that hard to replace, but most of us don't have access to the replacements needed. For now, let's just keep to through-hole construction. That's what most of us come up against when working on a home-brew project or a kit.

Through-hole desoldering

As the name implies, through-hole desoldering involves removing solder from a hole on a PC board. There are several methods used today, and I've added a few hints and described some kinks I've discovered along the way.

You're building a kit and you have noticed a solder bridge between two adjacent pads. The kit uses a single-sided PC board.

Now, I get madder than Jim Bowie with a dull knife over solder bridges on a circuit board! It only takes a whisker of solder to stop a circuit dead in its tracks. They're so easy to make and so hard to spot! But once you have found the solder bridge, it's usually easy to get rid of.

To remove this kind of solder connection, you can try a few tricks. First, wipe off all the solder on the soldering iron's tip. The tip should be hot, clean and dry. Now, apply heat to *one* side of the solder bridge. In most cases, heating up the pad will cause the solder to wick up the tip of the soldering iron, removing the solder bridge.

If that doesn't work, clean the soldering iron tip again and apply heat to the *middle* of the bridge. Again, the solder should wick up the tip, eliminating the solder bridge.

Here's another variation you can try: Turn the PC board over, so gravity helps the molten solder move towards the soldering iron's tip. Using these methods, you can remove a solder bridge between IC pins and adjacent solder pads without much fuss. However, there are times when you need a bit more help.

"My SBY method really works."

Desoldering braid

Several different manufacturers make desoldering wicks. I use a product called "solder wick." I also have had good luck with Chem-Wik™ brand. Basically, a desoldering wick is a web of fine copper wires braided together and soaked in a chemical flux. As a matter of fact, you can use the braid from a piece of junk coax and some soldering flux to make a hunk of emergency solder wick. To remove solder from a PC board, you apply heat to melt the solder and the braid wicks the molten solder up.

The first step is to determine the proper size of the wick braid. The stuff comes in various widths. Desoldering wick is not a one-size-fits-all product. The thinnest material is great for removing solder between IC pins. The larger width is used for larger and more heat-resistant joints. You can purchase desoldering wick in .030" through .190" widths.

The idea is to heat up the wick and the solder joint at the same time. If you use a wick that is too large, you risk damage to the PC board. Plus, if you've inserted a part backwards and plan to use the part again, too much heat can damage it. Also, too wide a wick will suck up the heat from the iron, making it more difficult to remove the part. I use .062"-wide desoldering wick for most IC pins and quarter-watt resistors.

Let's say you want to remove an IC chip from your circuit board using desoldering wick. Select the proper size wick for the job. If you can, replace the soldering iron tip with one that is wider than it is pointy. You want to get heat to the joint in the shortest time possible. A needle-type iron tip is fine for soldering the part in, but you need something blunt to remove it. Be sure the tip of the soldering iron is clean and dry. You may want to "tin" the tip by melting solder onto the tip and then wiping off the molten solder. Excess solder on the tip will just get sucked into the soldering wick, leaving the solder on the PC board untouched!

Now, put a clean piece of desoldering wick on top of the joint. Apply heat to the joint and in a second or two the solder will melt and be sucked up into the desoldering braid. You may have to repeat this procedure if the joint had an excess amount of solder.

The secret to using desoldering wick is getting the joint hot as quickly as possible. In most cases a 15 watt soldering iron will not have enough "oomph" to heat up the joint, the solder, and the wick. As a rule of thumb, if it takes longer than three seconds to desolder a joint, then the iron is too small or the joint is too large. I keep a soldering iron at my side just for desoldering—a 45 watt iron with a large flat tip.

Tools, tips and suckers

All the examples I've given so far deal with single-sided PC boards. Double-sided PC boards with plated through holes require an entirely different approach.

As the name implies, plated through holes have a layer of copper deposited in each hole on the PC board. This plating is about .003 inch thick and connects the top half of the PC board to the bottom half. For most of us, that's all we'll ever see. However, it is possible to have up to 16 different layers connected to each other by plated through holes. But for right now, let's just worry about double-sided boards with plated through holes.

Unless you're really into pain, using desoldering wick on a double-sided PC board with plated through holes can be a real pooper! The wick will get the solder from the top side. Flip the board over and you can get the solder off the bottom side. However, you'll still have solder hiding inside the hole, clinging to the copper plating.

All right, here's how to get a part out of the PC board without spending a bundle on vacuum-desoldering equipment. Well, actually, there are two ways. The first is my personal favorite: the slash/burn/yank or SBY method.

Resistors are the easiest to remove using my SBY method. Since resistors are cheap, it doesn't pay to save them. So grab your side-cutters and clip one lead of the resistor as close to the resistor's body as possible (you can also just cut the resistor in half). With needlenose pliers, hold the resistor's lead and apply heat to the lead from the *top* side of the PC board. When the solder melts, yank the lead out of the hole.

Now that the leads are out of the board, you need to remove the solder from the holes. This is the second part of my SBY method.

You'll need a stainless steel needle. A needle, not a pin. You'll need something small to hold the needle, and the best tool to use is? Needlenose pliers, of course! From the top side of the PC board, place the tip of the needle on top of the hole. Heat the needle with your high-wattage iron. As the solder begins to melt, push the needle through the hole. Remove the needle. Since the needle is made out of stainless steel, the solder will not stick to it. This opens up the hole, allowing you to install the replacement part.

As simple as my SBY method sounds, it really works. But what about those parts whose leads you can't get to? Crush 'em! For disk capacitors, cut them in half. Use a small screwdriver to pry off the tops of electrolytic capacitors, leaving only their leads. Use slip-joint pliers to crush the bodies of tantalum capacitors.

For ICs you'll need a small sharp side-cutter. At the *body* of the IC, clip off its leads. Now you can remove the pins one at a time. Clean out the holes and install the new IC.

It doesn't take Mr. Wizard to tell you that the parts you remove are history when using my SBY desoldering method. However, there is a certain amount of vengeful pleasure in crushing the dog snot out of a part that took three hours to find!

> ***"Neglecting this simple cleaning step will destroy most irons."***

You always want to apply enough heat to the joint to have the solder flow freely inside the hole. If you don't, you may pull the copper plating out of the holes. You can easily tell by looking at the leads of the part you just removed: If you see a copper ring around the leads, you've pulled the plating out of the hole. With the plating no longer inside the hole, you must solder the top and bottom foils to the component lead of the replacement part. And sometimes you can't get to both sides of the board, so be sure to use enough heat to get the solder molten before you start yanking out the leads.

Super suckers

Using the needle works for small jobs, but it's time-consuming. There are other methods of getting the solder out of a hole.

The cheapest is a desoldering bulb. You squeeze the bulb, heat up the joint and place the tip of the desoldering bulb on the hole. When the solder is molten, you release the bulb. In theory, the molten solder is sucked up into the bulb. In real life, I find, it works better if I *blow* the solder out of the hole from the top side.

Spring-loaded solder suckers work just like the bulb, but are spring-loaded to supply a faster and more powerful sucking action. Alas, these things work even worse for me than the desoldering bulb! I'm sure there are many hams using these things with great success, but I'm not one of them.

Super super suckers!

If you have the money, the best bet is to get a vacuum desoldering station. Usually they come with interchangeable tips and heater elements. Always be sure to check out replacement tips if the price of the iron seems unreasonably cheap.

I purchased a unit with a built-in pump. I chose a Weller model. Other companies, such as Pace and OK Industries, also make desoldering equipment.

Because the desoldering irons have higher wattage heating elements and an instant vacuum they are able to suck the solder out of a hole in a few seconds. It's best to allow the iron to heat up the joint until the solder becomes molten. Then hit the vacuum. In an instant, the hole is clear. Sometimes it helps to wiggle the lead with the iron's tip to make sure the lead is clear from the sides of the hole. They are worth the money if you need to repair double-sided PC boards on a daily basis.

Because of the flux and old solder, desoldering equipment can be a maintenance problem. Be sure you always have gaskets, seals and other necessary replacement parts on hand.

Unlike that old soldering iron, desoldering irons need to be cleaned each and every time they are used. Neglecting this simple cleaning step will destroy most irons. In some cases, if you use the desoldering iron for hours on end each day, you may need to run some thinner through the vacuum pump to prevent the pump from seizing up. Just don't do it with the heating element on!

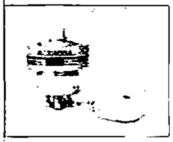
The best way to prevent damage to a PC board and to find the screwups is to put the right part in the right location the first time. But then you would miss all the fun of troubleshooting your own gear!

Number 40 on your Feedback card

NEW PRODUCTS

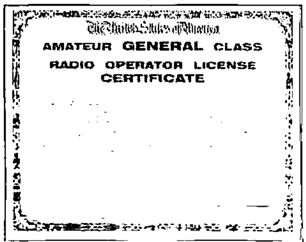
Peaceful Coexistence

Russian manufacturer Svetlana announces the new 4CX400A high performance tetrode designed for linear service. Svetlana's innovative electron focusing and trapping configuration



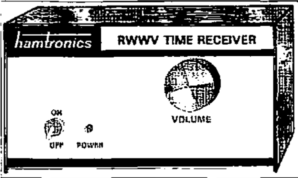
reduces anode secondary electron emission, achieving increased conversion efficiency, with low intermodulation distortion. A single 4CX400A will produce 600 watts PEP at only 2500 volts DC, and three in parallel will conservatively produce the legal limit of 1500 watts PEP and key down CW with bullet-proof reliability.

The inexpensive but rugged Svetlana SK2A ceramic socket is available for use with the 4CX400A tetrode, and together they will withstand severe shock and vibration. Contact Svetlana for technical information and a list of other Svetlana products for amateur radio applications. Svetlana Electron Devices, Inc., 3000 Alpine Road, Portola Valley CA 94028. Phone (800) 578-3852/(415) 233-0429; FAX: (415) 233-0349.



License Certificate

The classic FCC Amateur Radio License certificate is back! Originally issued only to Amateur Extra Class licensees until government cutbacks in the 1980s. FCC-approved certificates are now available for every amateur class. These license certificates have been meticulously recreated and are printed on the same high-quality paper as the originals. They are $14.95. Contact License Certification Service at 800-79-CERTS (792-3787) or on the web at: http://www.quiknet.com/certs.

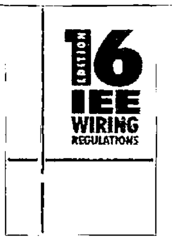


Listen In on the World

Hamtronics, Inc., has just announced a new low-cost dedicated receiver for listening to the 10.000 MHz WWV broadcasts. Don't let its small size fool you—the model RWWV is a very sensitive and selective AM superhet receiver PCB module, crystal-controlled on 10 MHz. Easy to build and align, it's a fun project, even for beginners.

The RWWV operates either on a 9-12 VDC power supply or a 9V battery. It has a 50Ω input so you can connect it to any type of HF antenna, and it's so sensitive you can get good reception with just a small length of wire or an indoor whip antenna. And the complete kit is only $89! You can also get a kit to build just the PC board module for $59, or buy the unit factory-assembled in a cabinet with speaker and AC power supply for a very reasonable $129.

For details, write to Hamtronics, Inc., 65-D Moul Rd., Hilton NY 14468-9535, or call (716) 392-9430; FAX (716) 392-9420. Be sure to tell them where you found out about the RWWV, and while you're at it, ask for a complete catalog.

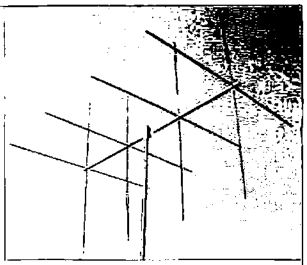


When You Have To Wire

We hams, being experts with electricity, can get drafted to deal with electrical wiring. If (or when) *you* do, you're going to need to know something about wiring regulations. For $29.95 you can invest in Brian Scaddan's *16th Edition IEE Wiring Regulations*, from BH Newness. 96 pages of everything and a half you need to know when dealing with the 120-volt monster.

New from the Cubex Hive

Cubex's new sideband antenna, the "Queenbee," is a 6 meter 4-element pretuned quad antenna, all Fiberglas™ construction with a heavy-duty aluminum mast-to-boom coupler. The Queenbee is fed directly with 52 ohm coax and features Cubex's exclusive tuning block, which allows the antenna resonance point to be adjusted slightly without completely changing the wire elements. Plus, the "Queenbee" comes with the driven element premarked for a resonant frequency of 50.2 MHz, giving the antenna a bandwidth of slightly less than 1 MHz at an SWR of less than 1.7 to 1.



The Queenbee is easily assembled and adjusted, but the best feature is the price: only $159.95 plus s&h. For more information, contact Cubex, 2761 Saturn St., Unit E, Brea CA 92821. Telephone (714) 577-9009); FAX (714) 577-9124.

EDX-2 Automatic Antenna Tuner

Alinco Electronics' new EDX-2 is designed to provide a quick match between antenna and transceiver, with the ability to match a length of antenna from eight to 80 feet, on bands from 10 to 160 meters (a minimum antenna length of 40 feet is required for 160 meter operation).

The EDX-2 uses computer logic to operate a network of capacitors and inductors to find the combination presenting the lowest possible SWR to the radio. Mobile users have added flexibility in using an eight-foot whip when in motion, or adding a length of wire to the stationary whip to improve HF operating performance.

The EDX-2 comes equipped with a control cable interface designed to plug directly into the Alinco DX-70 HF radio, but the unit can be adapted for use with other manufacturers' radios. It is enclosed in a weather-resistant case, suitable for use in mobile, base and marine operations, and can be operated in a horizontal or vertical position.

The suggested list price is $344, but check with your dealer because you may be able to pick up this briefcase-sized unit for less.

For more information, contact your dealer or Alinco Electronics, Inc., 438 Amapola Ave., Ste. #130. Torrance CA 90501. Phone (310) 618-8616; FAX (310) 618-8758.

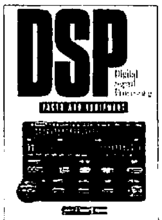
Two Pocket-Size Winners from SGC

SGC, "the SSB people," announce the publication of two new HF-SSB-oriented books: *Go Mobile at 500 Watts* and *DSP: Facts and Equipment*.

Go Mobile has chapters on the basic layout of a mobile system, on power for a 500-watt mobile system, antennas and grounds, noise and vibration, and on installation, with instructions based on SGC's own technicians' experiences in four specific vehicles—but their tips can be applied to any manufacturer's high frequency gear.

DSP is an education in how sound is recorded and reproduced, on the comparison of analog to digital filtering, on DSP in high frequency communications, and on the future of DSP.

Both books are available (suggested retail price $19.95 each) from ham dealers and from SGC, Inc., P.O. Box 35326, Bellevue WA 98009. For more information, call the SGC Marketing Department at (800) 259-7331.



Number 41 on your Feedback card

Atomic Keyer from Embedded Research

'A lot of BANG! for your thirty bucks.

Marshall G. Emm AAØXI/VK5FN
2460 S. Moline Way
Aurora CO 80014
75230.1405@compuserve.com

As we used to say in the Air Force, close doesn't count, except in three sports: horseshoes, cowpie fights, and nuclear war. For us old Cold Warriors, it's a huge relief that nuclear war is less likely with every passing month. But we must still be vigilant—any nuclear detonation could send us back to the Stone Age of radio, and we Morse operators may have another heyday. I, for one, will be prepared, because I have an Atomic Keyer from Embedded Research. The AK comes close to being the perfect keyer for field and emergency operation.

No, the Atomic Keyer is not nuclear-powered. As far as I can tell it isn't even radioactive, though it will certainly help you to be "radio active." The AK-1 is a $30 kit which lets you build the least expensive memory keyer on the market, with a surprising number of features and specs, all the result of clever PIC programming. The catchy name comes from the secrecy surrounding its development by designers Gary Diana N2JGU and Brad Mitchell WB8YGG. They began working on the project early this year, and QRP guru, Bob Gobrick VO1DRB, asked them what they were working on: "...some kind of atomic keyer or something?" The name stuck.

"The least expensive memory keyer on the market, with a surprising number of features and specs."

By the time Dayton rolled around, the project was finished. A prototype had already been reviewed electronically on the QRPer's Internet lifeline, QRP-L*. Brad and Gary sold most of their first production run at Dayton, and a bunch since, mostly via mail-order and their Web home page: http://www.vivanet.com/~gmdsr. I mention this because the timing is amazing—from concept to packaged kits in about three months—and we're going to see a lot more of this in the years to come!

The Atomic Keyer features two static memories, two dynamic memories (total 64 bytes), a piezo transducer for audio output, switchable send/practice/tune modes, and variable speed iambic keying with standard 1:3 weighting. Current consumption is very low—typically around 300μA when idle and about 1mA key-down when operated from a pair of AA batteries—giving a useful battery life of about six months under normal operating conditions. Because the power requirements are so modest, no on/off switch is required (or supplied), but I added one for reasons which will be discussed later. As supplied by Embedded Research, the AK-1 kit includes everything you need except for a power source (3-5V supply, e.g. 2 AA or AAA cells), battery holder, and an enclosure.

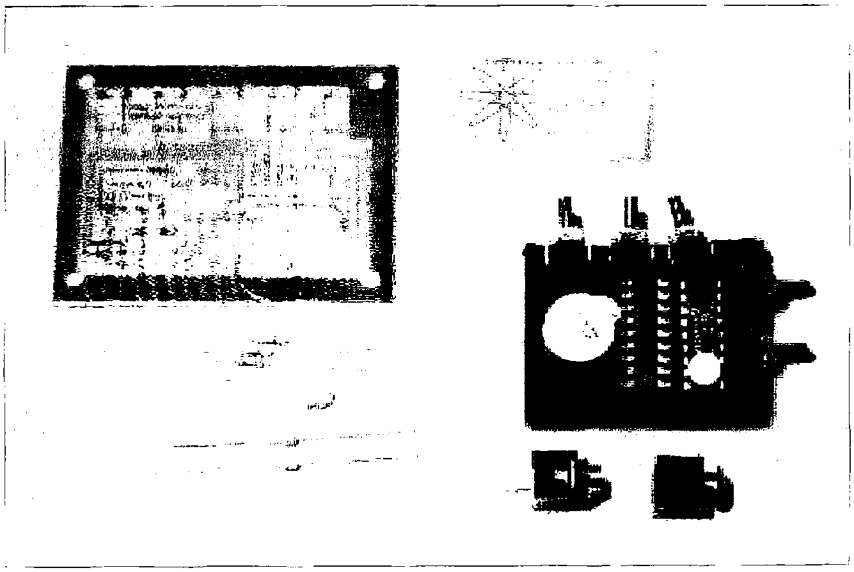


Photo A. Can you tell just how tiny the whole kit is?

Construction

You might be a bit surprised to find the kit supplied in a 6- by 9-inch catalog envelope, and you'll be astounded to find that the board and all the parts are in a tiny brown envelope. Apart from the board itself and the five push-button switches, there are only 10 components, including the microprocessor chip!

All of the components except for the (supplied) jacks for paddle and key-line are mounted on the circuit board, which measures about 2 by 2.75 inches.

Step-by-step instructions are included, and a builder with modest skills will have no trouble completing the project in less than an hour. The PIC16LC58A is an 18-pin CMOS device, so you want to be careful with its installation and handling. It is socketed, so you should leave insertion until everything else is done, and take the usual precautions against static when handling it. Soldering the pins on the IC socket is the only tricky assembly step. The solder pads are very close together, so it would be a good idea to solder under some sort of magnification and check each connection very carefully.

The instructions go into quite a bit of detail regarding the installation of the push-buttons. Read that part carefully, and do some measuring before you install the buttons! Theoretically, the buttons can be soldered directly to the component side of the board for mounting through a panel that is 1/8-inch thick. I took them at their word and found, to my chagrin, that there was not adequate clearance. One limiting factor (which was probably too obvious to mention in the instructions) is the height of other components—make sure the IC socket is mounted flush with the board, and that the chip itself is fully inserted. The switching transistor, Q1, also needs to be mounted as low to the board as possible. The manual gives you instructions for three optional mounting methods—shimming the buttons, mounting them on the foil side of the board, and remoting them.

I installed the completed keyer in a small plastic box (RS270-222), mounting the board and the jacks on the lid of the box. That was the point at which I found that the buttons didn't protrude enough for operation. Since the box is plastic, I found that I could create a single elongated hole surrounding all five buttons, allowing them to be depressed. That seemed easier than removing the buttons from the board and re-installing them on the foil side or shimming them. The box has room for an AA battery holder (RS270-382) and when finished, it's just a little blue box with two tiny jacks and five buttons on the top. You may want to use a metal box to suppress RFI generated by the microprocessor, but it was not a problem in my test environment.

If you hate batteries, it would be a simple matter to add a power jack or pigtail power lead, and, of course, a 5V regulator between any higher voltage supply and the existing +3-5V terminal on the board. A 7805 (RS276-1770) will do just fine.

There is a 10k resistor network, which is a component I hadn't seen before. I mention it because the little bugger is *fragile*. Handle with care, because a replacement won't be easy to find at your local parts store!

Although it isn't strictly necessary, I added a power on/off switch in the positive line from the battery holder. I did this because it is occasionally necessary to clear the keyer's memory, and it's a nuisance to open the box and disconnect the battery. Note that the dynamic memory in the AK-1 is volatile; that is, anything you have stored will vanish when power is disconnected. I don't see this as a problem since it's basically a CQ memory anyhow—it only takes a couple of seconds to re-record your callsign and optional second message.

The smoke test

The keyer essentially tests itself! As soon as you connect power to it, you will hear "AK 1" sent through the piezo audio output. There's not much that can go wrong, and if you hear the sign-on characters you are probably in business. If not, take another look at component placement and examine the solder joints. And if you still have trouble, Embedded Research is only an E-mail away.

Operation

Keying is clean and precise. As with all keyers, it will take a bit of practice to get used to the AK-1's "personality" or "feel." The ability to put the keyer into "practice" mode is great when you are first getting used to it.

The five buttons have the following functions:

1 send CQ CQ CQ DE DM1 DM1 DM1 K
2 send DM1 DM2
3 send DM1
4 send DM2
5 Set Speed: dits down, dahs up
1&3 Input DM1... Press 3 to finish
3&5 Input DM2... Press 3 to finish
1&4 TUNE Key output, stop by hitting paddle or button 4
2&4 Toggle On Air / Practice modes

DMn represents the two dynamic memories, in which you can store message text and/or your callsign. Where functions are shown with two button numbers separated by the "&" character, you need to press both buttons simultaneously to enable the function. An undocumented combination, 4&5, makes the keyer report its software version (v1.22 in the unit reviewed).

Memory usage is a bit unusual, in that the AK provides two dynamic message memories (you can load characters into them) and two static memories. The first static memory sends a standard 3 x 3 CQ call and when you send it, the AK will plug in your callsign from the first dynamic memory. The second static message will send the first dynamic message

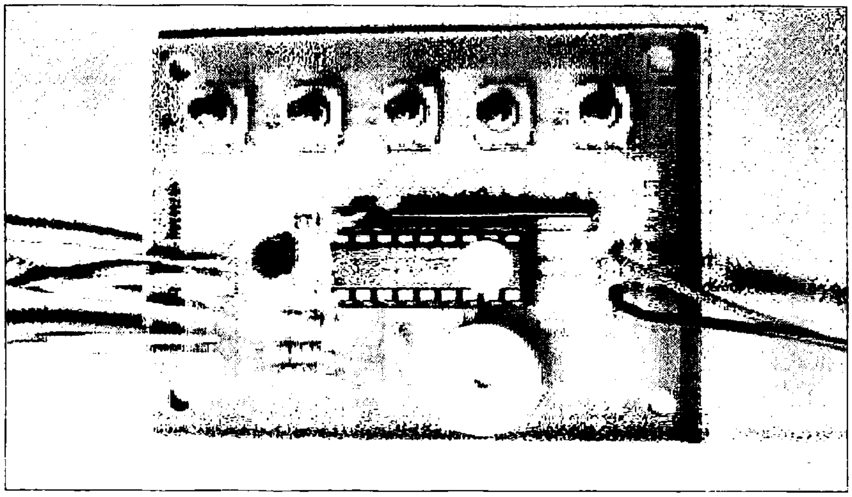


Photo B. Interior view of the Atomic Keyer.

immediately followed by the second dynamic message. Personally, I think it would make more sense to go with dynamic message memories only, because I often use something other than a standard 3 x 3 QSO—I usually end a CQ with AR or AR K rather than just K; of course, once in a great while I like to call CQ DX!

The speed setting is also a bit unusual, and not adequately described in the instructions. Pressing button 5 puts the keyer into speed setting mode, after which speed is increased by holding in the dah paddle, or decreased by holding in the dit paddle. You hold the paddle in until the keyer reaches the desired speed, then release it. If the rate of increase or decrease is too slow for you, you can "bump" it along by tapping the opposite paddle (without releasing the one you are using to change the setting). It seems a little odd at first, but you easily get used to it and of course it obviates the need for a speed control pot.

Conclusion

The Atomic Keyer is an excellent little kit, representing very good value for the money. It's unlikely to replace my CMOS-III for day-to-day use in my shack, but on the other hand, it cost less than half as much and it will be great for field and mobile work. Gary and Brian are very amenable to suggestions, and indications are that the AK-1 will be upgraded as users supply useful feedback. One of the great benefits of programmed keyers and PIC technology, as compared with, say, the 8044, is that an upgrade will be just a matter of popping in a new chip.

Availability

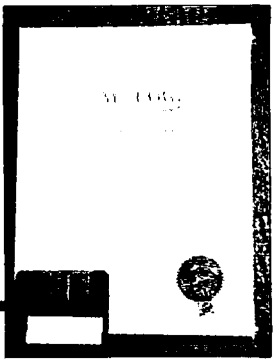
The AK-1 Atomic Keyer kit comprising circuit board and all board-mounted components is available for $29.95 (+$3.95 shipping/handling) from: Embedded Research, P.O. Box 92492, Rochester NY 14692. E-mail: gmdsr@vivanet.com.

*To subscribe to QRP-L, send a message to LISTSERV@lehigh.edu and use the following as the message text: SUBSCRIBE QRP-L your_name your_callsign.

Number 44 on your Feedback card

73 Review

M★LOG Logbook Program



It doesn't get much easier than this!

Larry Feick NFØZ
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Englewood CO 80110

Call me Ishmael. Oops, wrong story! Call me old fashioned. I believe in CW, I believe in tradition, and I believe that amateur radio operators are ladies and gentlemen. I also believe that the first and only purpose of amateur radio is communication; anything that gets in the way of communication is bad, and anything that facilitates it is good. If that makes me a curmudgeon, call me Wayne Green!

For years I resisted the idea of computerizing my logbook, mostly because the logging programs I ran into were cluttered, clumsy, and had a tendency to force me to change my logging and even operating habits to suit the program. Surely it should be the other way around, I thought—computers are supposed to help people by taking over part of the workload, not add to it!

I was reasonably happy with the system I had; a paper system that worked, and worked well, and I really didn't need a computer to do what I wanted to do. Besides, most of the logging programs that I have seen are either highly specialized for specific interests (like contesting), or are designed by hams who have no idea how to write a good computer program.

So when I was asked to review M★LOG, from Milestone Technologies, I had mixed feelings. I expected the process to be a waste of time and effort, and expected to continue doing things as I have always done them. Well, it *wasn't* a waste of time, and the great news is that this is a computer program that not only allows me to continue doing things the way I have always done them, much more efficiently, but adds a whole new area of possibilities.

From the moment you open the box, you see that M★LOG is different. The manual is comprehensive and well written, and installation is a snap—just put the disk into the drive and type INSTALL. Unlike so many programs lately, this installation program tells you what it is doing and gives you some options, such as where the program will be installed. There are also facilities for updating from earlier versions, and for importing log data from other programs (and for exporting data in several different formats).

As with any computer program, there are three key questions:

(a) What data can be stored (what goes in)?

(b) What can you do with the data once you've got it into the program (what comes out)?

(c) How easy is it to use?

"At the touch of a couple buttons I can see how many countries I've worked, and how many are confirmed."

Data

QSO records in M★LOG are stored in "tables," which you can think of as being an electronic log book. Just as you can have separate logbooks for different purposes, you can have multiple log tables. I ended up creating a universal "main" log, supported by separate temporary tables for specific purposes, such as the local QRP club's contest. That allowed me to look at the contest log separately and produce a printed log and QSL card labels, but I was also able to copy the contest entries into the main log so that I could have those QSOs included in my index of stations worked, and some statistical studies that I do from time to time. M★LOG allows you to establish an unlimited number of such logs.

The QSO data to be stored is a problem area with many logging programs. There are some aspects of a QSO which you will always want to record: callsign, name, location, date, time, band, mode, and QSL card sent/received. Beyond that, logging requirements depend on how you operate and what your goals are. Some people will be primarily interested in contests, others in awards, and so on. In fact, it's probably fair to say that no two hams will have identical logging requirements. Attempting to cater to everyone's needs requires either a lot of fields, or a lot of flexibility.

M★LOG's approach to this problem is to offer a flexible record structure in which the standard data items are predefined, along with some "nearly standard" things like text comments (recorded in three individual fields, or an associated text file of unlimited size), country (from a prefix table that you can edit and update) and fields to describe your "operating conditions" (rig, power, antenna).

But, this is where this one really shows its power—in addition to the data described above, you can actually define six separate fields for whatever purposes you want. When you first start using the program, two of these six fields are set up for states and counties, but you can redefine them if you want to. I've left those in place and defined a field for grid square, and left the other three for "ad hoc" requirements such as specialized contest exchanges. There are so many things that people track these days! A few examples are Regions, Zones, 10-10 numbers, club member numbers, power levels, IOTA numbers... the list goes on. And if you need more than six of these, no problem: M★LOG will let you create a duplicate table with six more definable fields, and so on.

The thing is, each of these user fields is indexed and reportable, so at the touch of a couple buttons I can see how many counties I've worked, and how many are confirmed!

On the other hand, you don't *have* to use any fields except for the callsign, and according to the manual, unused fields do not occupy any space on your disk!

Also, at the touch of a button, you can consult a CD ROM callbook and plug the relevant information into the QSO record (and also print out a mailing address to a text file). QRZ!© and Amsoft© databases are directly supported, and others can be used with a bit of configuring.

The bottom line is that if you can write it down on a paper log sheet, you can store it in M★LOG.

Getting it back onto paper

There are four basic types of data output you might need from your logging program:

(1) Look up and display a record on the screen.

(2) QSL data in the form of cards, labels, or data for use in another program.

(3) Actual logs, for contest entries and award applications.

(4) Data analysis, including an index of every station you have worked, activity by band and mode, or whatever it is you want to look at.

All of these are well supported, and again the program goes beyond the basic requirements and offers virtually infinite flexibility.

When you want to look up a callsign, you can select from a list ordered by callsign, date/time, or several other ways, or you can input a callsign or partial callsign. Either way, M★LOG looks to be very fast. I installed it on a 386, and with about 2,000 QSO records loaded into the program an individual callsign was found almost instantaneously.

QSL data can be printed in a standard label format, and you can modify the label specs to match whatever stationery you have. You can also output QSL data as a text file, as a delimited data file, or as a WordPerfect© secondary merge file. These formats allow you to pick up the data with another program to do the actual printing. For example, if you have enabled the external callbook facilities, you can output data allowing WordPerfect to print the data block on one side of a QSL card, and an address and other messages on the other side—resulting in a mailable postcard.

An advanced feature of both log and QSL printing is the ability to prepare output from a template that you design. The template is an ASCII file which you prepare with a text editor or word processor. In the template file you can include both literal text to be printed and also specify fields from the QSO record and where they are to be positioned. I found this feature is very handy when preparing contest logs, because it allows you to specify the contents and order of columns in the report.

Probably its most powerful feature is the ability to specify logical constraints for reports and on-screen selection lists. Requests are framed in a language which will be very familiar to users of dBASE and similar programming languages. An example of use would be something I did the other day; I requested a list of all confirmed CW contacts on 40m with DX stations where the other station and I were both operating QRP

But how do you drive it?

For all its power and flexibility, M★LOG is very easy to use. The program starts with a nice graphics screen, and the characters "ML" are sent, in Morse, from the PC speaker!

All of the various logging, reporting, and utility functions are organized in a rational manner, and the menu selections reflect the tasks in ways that are familiar and easily understood. Screens are nicely laid out, not cluttered with an excessive number of data fields, and you can move around easily with the keyboard or a mouse. Whenever the cursor is in a data field, there is a message at the bottom of the screen explaining what the field is for, and further help is available by pressing Function Key 1.

When you are entering QSO data, you can select from a number of "QSO Profiles" to provide some of the data automatically. I set up a profile for each combination of rig and antenna that I use, so I don't have to type in the information each time. And some fields are carried forward from one record to the next—fields like the band, mode, time and date, which often require only a minor adjustment. You can even set up your function keys to put specific information into specific fields.

The contest mode offers two optional methods, abbreviated and full record. In the abbreviated mode, it automatically generates serial numbers, and puts the current time in (calculated into Zulu from the PC's clock) when you press the Enter key. In the full screen logging mode, you have access to all of the data fields, so you can use your own defined fields for oddball contest exchange information like power level, member number, or first name.

"Dupe" checking is almost instantaneous, and unlike some contest programs you can continue and log a dupe. This feature is handy if you made the contact before you were able to report it as a dupe, or if there are contest rules that say, for example, dupes are OK if a certain time period has elapsed. The important thing is that it shows you all previous contacts with the station and allows *you* to make the decision!

You don't have to be a computer expert to install and use M★LOG: the basic functions are done just the way you would do them on paper, and the manual makes it easy to figure out how to do more elaborate tasks later.

What's missing? Things that I, for one, don't want! It doesn't have a keyer built into it, it doesn't directly control my transmitter, and it doesn't have predefined contest logs that need to be updated every year when the rules change. And only two of the more popular CD ROM callbooks are directly supported. If those features are critical to you, you can either use another program or write to Milestone Technologies and complain about how old-fashioned *they* are!

Wrapping up

I can say without hesitation that this is the best logging program that I have ever used, and it opens up a whole world of possibilities in analyzing my log data going back over 20 years or so. When you factor in the price (lower than most packages I see advertised) it becomes a bargain, too. M★LOG Radio Logkeeping System Requirements: Any DOS PC running DOS 2.10 through Windows 95™. Hard disk recommended.

Milestone Technologies, 3140 S. Peoria St. Unit K-156, Aurora CO 80014; (303) 752-3382. Credit card orders (Visa/MC/Disc/Amex) 800-238-8205. Price: $39.95 + $5.00 s/h in US and Canada.

Number 46 on your Feedback card

A Simple QRP Wattmeter/Dummy Load

OK, how many countries have you worked with 5W?

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Salinas PR 00751-0030

Ham QRP operation is a rapidly increasing interest and the number of commercial kit transceivers, transmitters and receivers is increasing proportionately. While many kits are designed for CW operation only, more are being offered which are capable of SSB as well.

The most important thing about QRP operation, and the main reason for its burgeoning popularity, is that it works! A lot of hams with QRO stations, having tried QRP, are amazed that Q5 QSOs are possible worldwide using just 5 watts or less. And they are intrigued by the challenge of chasing awards at QRP levels, awards many have already earned using high power.

A further reason for the enthusiasm for QRP is that many hams live in condominiums, apartments and small-lot subdivisions where high power is guaranteed to interfere with the multitude of nearby consumer electronic equipment. Switching to QRP generally eliminates interference without reducing the enjoyment of operating on the HF bands.

QRP is widely accepted as meaning a maximum of 5 watts PEP or less RF output to the antenna. Therefore, QRP enthusiasts are very interested in *knowing* the level of RF their rigs are putting out. The combined RF wattmeter/dummy load described here (**Fig. 1**) is designed to measure power levels between 1 and 6 watts of RF, to provide an overlap beyond the 5-watt level. In addition, the RF levels below 1 watt are not displayed, enabling the most important 1- to 6-watt range to occupy about 95 percent of the meter scale. This instrument is easily calibrated with a variable DC voltage of about 9 VDC to just over 25 VDC, monitored with a DMM to assure voltage accuracy.

"Switching to QRP eliminates interference without reducing the fun of HF."

The circuit

RF applied to J1 is dissipated by the dummy load resistor Rx. The peak RF voltage developed across the dummy load is rectified by D1, filtered by C1, and applied through meter multiplier resistor R1 to meter M1, which is bypassed for RF by C2. However, zener diode D2, between D1 and R1, prevents the passage of rectified voltage when the input power level is less than about 1 watt. Thus, only rectified voltage from power levels between 1 and 6 watts RF will be indicated on the meter.

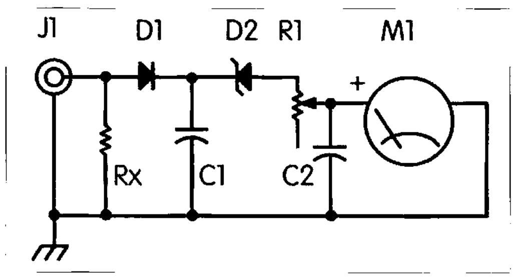

Fig. 1. Schematic for the QRP wattmeter/dummy load.

Because of the relationship between RF power and peak voltage across a known resistive load, the voltage variation is nonlinear, and is much more rapid at very low power than at higher powers. Measured on a meter, the change in rectified voltage from 0 to 10 volts (the equivalent of 1 watt) would take up the lower 40 percent of the meter scale, leaving only the remaining 60 percent for the power span from 1 to 6 watts. Using the zener diode to suppress this unwanted power range results in the 1- to 6-watt range using over 90 percent of the scale.

The calibration mark at 1 watt will be slightly above scale zero on the meter. Full-scale will represent 6 watts. The scale will still be somewhat compressed at the high end, but this is unavoidable.

Calibration

First you calibrate your meter. **Fig. 2** shows the setup for this. A source of filtered 9-25 VDC is needed. A DMM should be used to check the accuracy of the calibration voltages.

To maintain maximum accuracy, the meter must be calibrated using the same parts that will be used in the final instrument. With the parts tacked together and the meter face removed to expose the scale so calibrations can be made with a fine pen, and with R1 set to maximum resistance, gradually apply DC voltage at the input until it reaches 24.49 volts. Then adjust R1 so the meter needle rests at full scale. Mark this point "6."

Then lower the input voltage to 22.36 volts. Mark the point where the needle stops "5." This should be marked in red, if possible, as a reminder not to exceed the QRP maximum RF level of 5 watts.

Continue reducing the input voltage and marking the meter scale as follows: 20 volts, 4W; 17.32 volts, 3W; 14.14 volts, 2W; 10 volts, 1W.

An alternative method of calibration is available if you have access to an accurate low power wattmeter. Simply connect the wattmeter in line with a transmitter and the wattmeter/dummy load. Adjust your transmitter for the same power levels listed in the above paragraph, as measured on the known-good wattmeter, and mark the corresponding level on the face of the wattmeter/dummy load.

This completes the calibration. Replace the meter face, untack the components and proceed with construction.

If you are unfamiliar with the disassembly of meters please see "Use Those Surplus Meters," *73*, January 1992, page 42.

Construction

This instrument must be constructed in a shielded enclosure. An aluminum box or a case made of printed circuit board material is ideal. The meter size will dictate the size enclosure required. One of the small surplus edge or square plastic meters originally made for home entertainment equipment or CB radio, most of which have approximately a 200 µA movement, will allow compact construction. (I built mine in an LMB OOZ aluminum box which measures 2-3/16" x 2-1/8" x 1-3/4". The SO-239 on top almost makes it look top-heavy!)

"Lots of hams are amazed that Q5 QSOs are possible worldwide using 5 watts or less."

The dummy load uses six 300-ohm 2-watt 5% carbon film resistors (Mouser No. ME 262-300), connected in parallel. Ocean State Electronics carries 2% 2-watt film resistors, but not in 300-ohm value. However, a 270-ohm and 330-ohm resistor in parallel is equivalent to two 300-ohm resistors in parallel.

I chose to make my internal dummy load by bundling the six resistors together and soldering them in parallel at each end. I chose 12 watts rated dissipation so the load would just loaf along when dissipating 5 watts or less.

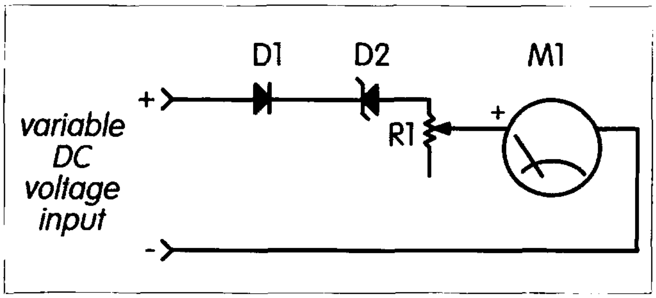

Fig. 2. Calibration setup.

Depending upon the size of the enclosure and the room remaining after mounting the meter, the dummy load resistors can be bundled together tightly, although this reduces the safe maximum dissipation rating. You've got 5 watts of heat you have to dissipate, somehow.

Operation

Because this instrument contains a permanently wired dummy load, it is intended solely to be used either to measure RF output from your QRP transmitter or to allow setting your rig for a specific output power before connecting the rig to your antenna or tuner.

Connect J1 to the antenna connector on your transmitter. The RF output power will be indicated on M1. If you can vary the output power from your rig you can easily set it for any desired power output between 1 and 5 watts. 73

Parts List

C1, C2	0.01 µF ceramic disc
D1	Germanium diode, 1N34, 1N60, 1N90, 1N270, etc.
D2	9V 400 mW zener diode
J1	RF connector, builder's choice
M1	Microammeter, 200-300 µA (see text)
R1	Meter multiplier trimpot, 150k Ohms
Rx	50 Ohm dummy load, home-brewed, see text

Number 48 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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Over the last few months we have been examining some basic concepts of radioteletype. This has been in response to a number of you who have written with the message, "Hey, I just came in. What's all this RTTY stuff about, anyway?" To date, a glossary of terms, fundamentals of character encoding, and methods of digital transmission have been covered. This month the series concludes with techniques for consummation of information intercourse.

Although there are several specialized ways to transmit digital data, this column will take a look at the three major ways of moving information this way, through conventional RTTY, AMTOR, and packet.

Conventional RTTY

Conventional Baudot, or Murray, RTTY allows transmission of data from sender to receiver, one way at a time. This is often termed "half duplex" communication. As we saw last month, the bits are sent sequentially, each character composed of a START pulse, data pulses, and a STOP pulse. In a RTTY transmission, the transmitting station sends data straightaway, nonstop, until the data stream is reversed, sender becoming receiver, receiver becoming sender.

For a classic RTTY station, data rates typically are 45.45 baud (bits per second), each data pulse lasting about 22 ms. Let's forgo some of the intricacies for right now. That means that a noise pulse would have to last a substantial time, perhaps at least seven to 12 milliseconds, to destroy a data pulse. Nonetheless, a nearby signal can take out letters, or groups of letters, with abandon. Unless the receiving operator questions the integrity of the transmission, errors in data exchange will neither be caught nor repaired.

AMTOR

Contrast this with AMTOR, in which seven-level code, a special AMTOR code, is transmitted at 100 baud. Here, each data pulse is only about 10 milliseconds. Consequently, a much briefer burst of noise can "take out" a data pulse, rendering that character so much garbage.

> "With AMTOR, erroneous groups are not displayed, they are dumped into that great bit bucket in the sky!"

So on the surface, as it is set up, you might get the impression that AMTOR is a much less reliable medium than Baudot for RTTY transmission. Not so fast, Kemosabe! Recall that Baudot RTTY is transmitted one way at a time, with the sender's brain responsible for filling in missing characters. Thus, if you are looking at a line which says, "TO ALL STJTIONS," your brain has little trouble realizing that the third word should be "STATIONS," particularly if I tell you that the Baudot codes for "A" and "J" differ by one bit. So monitoring a Baudot transmission is no problem. Everyone expects "hits" now and then, and you develop the knack for reading through them.

But with AMTOR, we will ask the system to do this for us. So, each character must meet certain bit matching criteria (let's forgo the details here, too) to be valid. And groups of characters containing an error are as invalid as random noise.

Erroneous groups are not displayed, they are dumped into that great bit bucket in the sky! Thus, if you are just monitoring an AMTOR conversation and receive a group of characters in which the character check does not compute, your receiving setup will toss it away, and you will never see it on the screen. Since you are not in communication with the sender, and thus have no way to re-request transmission of the group in question, it is lost forever. While there are one-way, or broadcast, modes of AMTOR which build in enough redundancy to allow for a certain number of hits, they are not typically used in contact type settings.

Allowed to operate as designed, though, AMTOR allows for virtually flawless transmission. With a noise-free circuit, the rates of data transmission can approach the maximum data rate being sent. With interfering or noisy signals, the receiving station will recognize the errors in transmitted information bundles and re-request transmission of that data. Under such conditions, the many retransmissions can slow information exchange to a crawl; but the data *will* get through, and get through perfectly.

Packet

Where AMTOR operates on a morsel of a few characters at a time, there is another technique that takes a different approach to error correction. Called "packet radio," this scheme organizes the data into discrete packets which have integral addressing and error-checking information, much as the XMODEM protocol used for computer program exchange. Each burst of data, called a "frame," contains:

- •An opening flag byte
- •An address field containing the address of the originating station, ultimate addressee, and any repeaters required in between
- •A control field which identifies the type of data contained in the frame
- •An information field containing up to 256 bytes of data
- •An error-checking field using the Cyclic Redundancy Check
- •An ending flag byte

These packets are sent by FSK or AFSK as fast as systems allow, with some work done on the air at 9,600 baud. In many areas, penetration of packet is such that information of some sort is always flowing through the ether!

While each of these techniques would appear superior in some way, whether simplicity, reliability, or speed, each has its champions, and each is "best" under a given circumstance. I look forward to hearing from readers as to how you all are using these, or other, techniques to move data. I should add that while conventional RTTY is limited to alphanumeric data, packet just moves packets of data. Those packets may assemble into text, graphics, sound files, or graphics, making this transmission technique invaluable to the transfer of complex information in this digital age.

> "Packet can transmit text, graphics, sound files or graphics, making it invaluable in this digital age."

In fact, the packet switching network that forms the heart of the Internet and the World Wide Web is only a slightly different form of the transmission technique used for amateur packet radio. Since we started RTTY with machines scavenged from commercial service, I guess we could say, "What goes around, comes around." Or at least LOOPs around! Lots of you have been logging in to the RTTY Loop Home Page, where back columns are available, as well as lists of programs available in the RTTY Loop Software collection, and many, many sites of interest to the radio amateur on the World Wide Web. Check it out yourself, at http://www2.ari.net/ajr/rtty/. Let me know what you think, and what you are interested in seeing in future columns, by snail mail to the post office box, or via E-mail to me at ajr@ari.net, or on America Online at MarcWA3AJR, or on CompuServe at 75036,2501. Above all, let me hear from you! 73

NEVER SAY DIE

Continued from page 13

The information on how to care for your body is available, you just aren't going to find it in the medical books. Just as you fight change, whether it be the code test, at your work, getting serious about dieting, etc., doctors tend to stay with what they learned in school. They don't spend much time keeping up. That might louse up their golf days or fun times spent at medical conventions (more golf). Yes, I'm cynical. I'd be less cynical if America wasn't down near the bottom in health among developed nations.

Ignorance Is Bliss

Sure, as long as you can be blissful when you are both poor and sick. A lack of skills and knowledge dooms one to either a career in crime or a non-demanding, low-paying job with little future. Ignorance of maintaining the body means chronic illnesses such as diabetes, arthritis, multiple sclerosis, Lyme disease, back trouble, heart attacks, glaucoma, cancer, AIDS, and so on. That's bliss?

Publishing Technology

Technology sure has changed publishing over the last three decades. When i started *73* in 1960 I would get typewritten copy from the authors. I'd then edit this with a pencil, using standard proofreaders' notation, and send it to the printer to be set in type. I'd picked Morton Press, in downtown Manhattan, a 60-year-old printing company that specialized in magazines.

The type was set on old Mergantheiler Linotype machines using hot lead. They'd ink the trays of type and send me galley proof strips for proofing and to paste up into page format. The photos, schematics, and other illustrations were sent out to be made into halftones and came back as thin copper sheets stuck on wooden blocks the same height as the lines of type. I would then cut the galleys and proofs of the illustrations to fit the pages and send these "pages" back to the printer to have the type and illustration blocks clamped together to print the pages. They would then correct any typesetting errors (often making more errors in the process), put the pages together and send me a proof of the assembled pages.

The last two or three days before press time were hectic, requiring me to be at the printer's plant to make last-minute corrections and then correcting the errors made in making the previous corrections. Printers had special rooms set aside for the editors to do this last-minute work.

Today most articles arrive in disk form and I edit them on my computer. The photos are scanned in by computer. The schematics are drawn by computer instead of by a draftsman. Then the copy and illustrations are put together in the computer and the finished page printed out on film for offset printing.

Continued on page 50

NEVER SAY DIE

Continued from page 49

When I was starting *73* I had to buy a stencil addressing system and a mimeograph. The addressing system used paper stencils which had to be softened with water before typing. There was a stencil holder that clamped on the typewriter platen, and typewriters had a stencil position that pushed the ribbon out of the way. The typewriter then cut the softened paper. The stencil printing machine weighed in at around 600 pounds. I'd stick stacks of the stencils into one side and it would slide them under an inked roller and print the address. At magazine mailing time I'd have to sit there for hours feeding magazine wrapper papers under the stencil printing area. Then I'd drive the cartons of wrappers to the printer in Norwalk, Connecticut.

How did I get *73* started? Well, I didn't have much money, so I first sent letters to every ham club I knew of, asking for subscriptions. I also wrote to all of the ham radio stores, suggesting they carry the magazine on their counter. By selling my boat, plane, and a Porsche I got just enough money to print 10,000 copies of the first issue. Around 300 stores ordered copies, plus I had around a thousand paid subscriptions. By the third issue my 10,000 print run was too little and I ran out of copies to sell as back issues. Within two years I had over 850 ham stores selling the magazine and the subscriptions were pouring in.

Having edited *CQ* for five years, I knew all of the ham authors, so I asked them to consider my new magazine when they were writing construction articles. Despite all my travels the year before, when I was fired from *CQ* I had five whole issues completed and ready to go. Their new editor, outside of getting bogus ham tickets for the *CQ* staff, had little to do. When it finally came time for him to do some work he couldn't do it and he was fired.

The *CQ* publisher wanted to stop running construction articles and just run columns, so my old authors had no choice but to turn to *73*. They, understandably, wanted to get paid something for their work, and *QST* paid nothing except prestige for their articles, so I had the first choice on most construction, theory and product review articles.

Just 13 years ago, when I was forced to sell my whole magazine empire to one of the megapublishers (or else!), I started over. At that time it cost me over $500,000 for the latest in a computer publishing system. Now, for under $1,000 you can do almost as much as we could with that half-million-dollar system. A used Mac PowerBook© and a used laser printer and you're in business. I still do some of my work on a $500 (used) Model 140, though I've graduated to a faster and larger-screened Performa® Mac for most of it. But even the fastest new Mac and the latest in film printers cost less than $50,000 now, down over 90% in 13 years. And prices are going to nothing but continue to go down as faster processors, cheaper RAM and bigger storage devices appear.

There are few businesses that couldn't be helped with a newsletter and an easy way to generate promotions, so we'll be seeing more and more in-house publishing. There's a great opportunity there for people to become experts in this technology and consult for small businesses.

Outraged

I am outraged over the outrageous things people are getting outraged about. I'm up to here with political correctness and with the seemingly endless euphemisms invented to spare people's increasingly delicate sensibilities. Mental institutions, correctional facilities, Department of Defense, physically challenged, senior citizen, chairperson ... phooey.

More Bum Dope

A reader from Ohio claims the HamVention speaker chairman told him he didn't ask me to speak this year because I demanded a speaking fee, plus travel and hotel costs. I don't charge a speaking fee for hamfests. I do usually ask that my travel and hotel expenses be covered, though I did not ask this of the HamVention.

Here's exactly what I wrote to Ken Allen KB8KE: "While I was disappointed to again not be invited to be on the program, I can understand the pressures you must be under from the League... I'm their worst nightmare and you certainly can't afford to offend them. I've heard from several sources how they're gloating over being able to keep me off the program.

"My message this year is the most important I've had since I first spoke at Dayton in 1955, where I addressed the banquet. I'm calling for every ham club in the country to do their utmost to get at least one local ham elected to their state legislature. The next step is for this person to get on the educational committee and introduce a bill getting the state's schools to initiate an eight-year course in the fundamentals of electronics, communications and computers for grades 5-12.

"Our country desperately needs high-tech career workers to design, manufacture, sell, operate, and service the high-tech products which will dominate both business and home in the 21st century. This can help us get radio clubs started in every school in the country and revive the high growth we had from 1946 to 1964 (11% per year, steadily for 18 years!). Without something dramatic like this, how many years can we really hope to keep our hobby going, considering the mounting commercial pressures for spectrum and the billions they are willing to pay for it? Ham legislators have an added benefit to us of being able to provide some clout when matters of interference and antenna restrictions come up. We need to infiltrate the state legislatures, so I'm really disappointed that I won't be able to get this message across at the HamVention this year."

No, I didn't get any answer.

Most conferences pay the travel and hotel expenses for the speakers. I spoke at the Tesla Society in Colorado Springs, the Global Sciences Congress in Tampa, and the Edmonton Ham Convention last year on that basis. But it's tough for me to take the time to give talks, so I haven't been pushing it.

Ideas

If you'd follow the instructions in my $5 booklet, *Making Money, A Beginner's Guide*, you wouldn't have to have me think up ideas for ways to get rich. I keep coming up with great ideas for new businesses on at least a weekly basis. There are endless products and services which would sell well, but which aren't on the market yet.

When I was a kid I got a pair of in-line skates, but having just two wheels, they weren't easy to use. By adding a couple more wheels an entrepreneur has racked up hundreds of millions. How come you didn't think of that? Well, there's a wide-open opportunity for someone now to use modern materials and invent a pair of roller skates (the old kind) that are light and can be simply snapped on a pair of (probably special) shoes. What a great answer to getting around our cities! Beats the heck out of walking. But they have to be simple to put on and take off, and easy to carry around. The market? Millions upon millions of pairs for use in every city in the world. Yes, I've written about this before, but you haven't done anything about it yet. I don't want to hear any complaints about your not having money.

How about an idea for a new and badly needed publication? I sure wish I had the time to do this. This has to do with helping food companies introduce new products. Hundreds of new products are being put into our supermarkets every year, and zillions of dollars are being spent to build their sales. How about a magazine to sell at checkout counters which would provide information about these new products? I'd encourage the public to try the new products and then report on how they liked them. A vox pop approach. None of us put much credibility on product endorsements in ads, but where an independent magazine publishes customer reactions, this would be much more believable. And this is something no company could generate through advertising.

Yes, there would be both good and bad reviews. This is what I did when I published *CD Review*. It's the only way to maintain credibility. Sure, the major labels really hated it when we trashed one of their new releases, but since our readers were spending about $25-30 million a *month* on CDs, they had no choice but to advertise in my magazine.

It's different when it comes to high-ticket products like audio equipment. There my policy was to only publish favorable reviews. But we never did a favor-

able review on anything that didn't deserve it. This is my policy with *73* too. If a product is good, I want to help the manufacturer to sell it. If it isn't very good, we just keep quiet.

With the food business there are so many new products and their cost is low, so the reviews should be brutal where brutality is called for. In the long run that's helpful for the manufacturers too. It shortens the agony for crappy products and the company will lose much less in the long run.

Would supermarkets make room for a new magazine? Anything that helps them bring in more customers and sell more products will get good placement.

Yes, I seem to often think in terms of publications. Well, they're easy to start small and build. With today's desktop computers anyone with $1,000 can get into publishing.

How about a magazine or even a flyer called *Killer Bs*? This would review the B movies on tape, and there are thousands of 'em. Some are darned good, but how can you find out about 'em? You sure can't tell from the package. I might even rent some videos if I had a way to tell what was good.

For that matter, we need a lot better system for reviewing first-run movies. Oh, I tape "Sneak Previews" and Siskel and Ebert to see what they think, but I haven't found them very reliable. My idea is to go to the first showing of a new picture and poll the emerging audience. How did they like it? You could hire a dozen high school students to poll a couple audiences and you'd have information that would support at least a newsletter. I'll bet you could get a radio or TV spot on the news with your results too.

Next thing you'll be reviewing plays, new museum exhibits, and so on, the same way.

One idea I wrote about several years ago and you ignored had to do with organizing a CD for graduating high school and college classes. You'd get together with a local recording studio and make recordings of the bands, choral groups, etc., as a graduation keepsake. It would be like the photos of the graduating class.

There are a lot of schools within driving distance, so you could work up quite a business.

Just keep your eyes open and your imagination on the front burner and you'll be able to think of all sorts of part-time money-making opportunities.

If you have a computer and laser printer you can start doing newsletters for local businesses. They don't have the personnel, the time, or the equipment to do them, but a newsletter is a powerful selling tool. And by the time you're doing a dozen of 'em, you'll be very busy. The next thing you know, you'll be keeping their mailing list for them too.

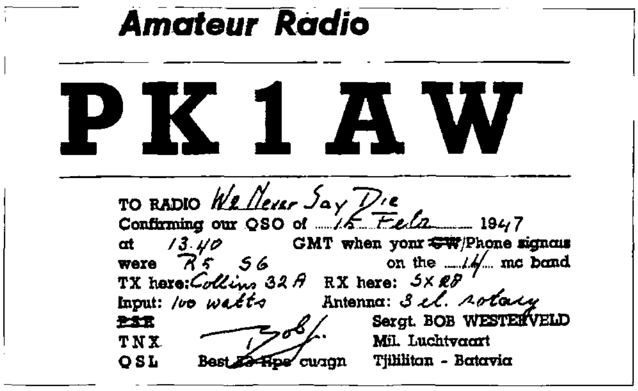
That ought to hold you for a while. If you'd like to read about more of my brainstorms, let me know. There's no shortage.

More Ideas

Money-making ideas, of course. There are all sorts of products and services out there just crying for entrepreneurs to step up and take a swing. Some will provide a fun and profitable life for you. Others will give you the opportunity to make millions—which is okay, as long as you don't get caught up in the pursuit of money as a goal in itself.

One wide-open opportunity is in the organization of hi-fi shows. Back in the 1950s, when I started my first manufacturing business, making loudspeaker enclosures, my main sales tool was demonstrating my product at hi-fi shows around the country: New York, Boston, Washington, Chicago, Los Angeles. These shows were in hotels and were packed solid with people listening and buying. Without those shows my speakers never would have become the best selling speakers in the country within two and a half years of their introduction. But I don't know of anything like that happening around the country now, and I'm too busy to do it, though I know the ropes, having put on a whopping computer show in Boston.

What happened to the shows? The industry, under pressure from Avery Fisher, took control and that was the end of it. Industry groups tend to be slow to meet changes. Look what happened to the IEEE and the NCC shows, once the largest in the country in electronics and computers. Pffft. Showmen can run successful shows, not committees.



Cold Fusion Gets Easier

When Doctors Pons and Fleischmann, two respected chemists, stuck a palladium wire into a lithium and heavy water solution, and then passed a current through it for some days—suddenly the cell started generating far more heat than any chemical reaction could explain.

Other scientists tried to replicate the experiment using palladium wire, sheets, and chunks. Many failed, but some succeeded. Those who failed went to the press to exposé P&F's fiasco. Those who succeeded kept working to refine to process—to make it work faster, more dependably, and generate more heat.

Physicists were adamant that this was not fusion because so little radioactivity was detected. Impossible. So, lacking any theory for why this "anomalous heat" was being generated, researchers went by the seat of their pants (empirical, it's called), trying this and that. Some were even getting heat using nickel and plain water.

The effect was best with metals having a lattice-like molecular construction such as palladium, nickel, rubidium, rhodium, and platinum. These metals acted like sponges, absorbing hydrogen. They found that around the time the lattices were 85% full of hydrogen the anomalous heat started appearing.

Jim Patterson, an inventor, and not a chemist or physicist, figured that since the start of the reaction depended on the metal absorbing hydrogen as quickly as possible, the more surface area of the metal, the faster it would absorb the hydrogen. So he coated some microspheres of polymer with palladium. Sure enough, the reaction started reliably in record time—in a few minutes instead of days. And the amount of heat increased amazingly. By last December he demonstrated a cell at a power company conference which was generating over a thousand watts of heat with only about one watt of drive. A thousand to one!

Hmm, said I, if those microspheres work so well, why not eliminate the spheres and just use cheaper and easier-to-make finely powdered metal. That would have even more surface area. Or go the next step to a chelated metal? Heck, go to even smaller metal particles by making a colloidal suspension of the metal in the electrolyte solution? Talk about surface area!

When I asked Patterson about this, he smiled and said he'd done just that and had some patents in the works. Jim's the chap who got the first cold fusion patent on his cell, and then the first patent claiming more energy out than in. Since that smacks of perpetual motion, which the patent office has always refused to even consider, this may be a historic first. It's real enough so Motorola and Bectel are already said to be licensed to help develop the technology.

Lest yon think that colloidal metals are something mysterious and difficult to brew, they're something you can make on the kitchen table yourself. In minutes. No, this cold fusion research field doesn't take a million dollar laboratory to get in on the fun. Indeed, the leading American researcher in the field (before Jim) was Dennis Cravens, a young teacher at a small college in Vernon, Texas. Dennis set up a small lab in his garage and, investing less than $5,000 in his equipment, was a true pioneer. I first met Dennis when he was delivering a lecture on his

Continued on page 55

Number 52 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

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New repeater in orbit

A new UHF repeater is in orbit using the callsign RRØDL. It's part of the Space AmateurFunk EXperiment (SAFEX) from Germany, and is fully operational from the *Mir* space station. You can work stations across North America via this 70 cm in-band FM repeater in space. Although it helps to use a home station with directional antennas and reasonable power, many stations have had successful contacts through the repeater using only handie-talkies and "rubber-duck" antennas.

What is SAFEX?

On October 30, 1985, the space shuttle *Challenger* was launched carrying the first German Spacelab mission. During the week-long mission a special crossband transceiver from Bosch was used by Dr. Reinhard Furrer DD6CF, Dr. Ernst Messerschmid DG2KM, and Dr. Wubbo Ockeis PE1LFO for ham radio contacts. The uplink was on channels between 437.125 and 437.375 MHz with a downlink on 145.575 MHz. Several hundred calls were heard by the German Spacelab hams and dozens of successful contacts were made. This was the first German amateur radio operation from space. Since then there have been several.

In 1992, the German ham activities went to *Mir* using the callsign DP1MIR. The second German Spacelab mission followed in 1993, once again with the callsign DPØSL. In the next two years the Russian-ESA (European Space Agency) operations continued with the DP3MIR endeavor in 1994 and the DPØMIR project in 1995.

In 1993, discussions and negotiations ensued between NPO Energia and Russian radio amateurs concerning future ham radio gear and operations onboard *Mir*. A new ham radio station for *Mir* was proposed. In 1994 three groups in Germany agreed to fund, design and build a new system to be mounted in the "Priroda" module in *Mir*. The German groups included the *Deutscher Amateur Radio Club (DARC)*, the Ham Radio Group at the German Aerospace Research Establishment (*DLR*) and the *Deutsche Agentur fuer Raumfahrtangelegenheiten (DARA)*. The Russians supported the installation in the "Priroda" module and the operation of the station.

Experience with earlier German and Russian space missions showed that astronauts and cosmonauts are very busy. The SAFEX-II system was developed to allow ham radio activity without constant intervention by orbiting hams. The popularity of the digital packet radio digipeater system used by the Shuttle Amateur Radio EXperiment provided a good model, but did not provide any unattended voice activity that a "flying" repeater can provide.

Mode 1: NBFM UHF Repeater
Downlink: 437.950 MHz
Uplink: 435.750 MHz
CTCSS Tone required for access.
Mode 2: 9600-Baud Packet
Downlink: 437.975 MHz
Uplink: 435.775 MHz
No CTCSS tone required.
Primary operation: digipeater.
Mailbox active with onboard laptop.
Mode 3: QSO Operation with *Mir* Crew
Downlink: 437.925 MHz
Uplink: 435.725 MHz
CTCSS tone required for access.
Digital voice recorder can provide beacon messages.
Packet transmission of digital pictures.
SHF Experiment: 10-MHz-wide linear transponder
Downlink center: 2410 MHz
Uplink center: 1265 MHz
Uses include high-speed data, ATV (FM or AM), etc.

Table 1. SAFEX-II frequencies for RRØDL on Mir.

The gear

The SAFEX system is comprised of two main units with various auxiliary components. The equipment weighs in at around 30 kilograms. Three external antennas are needed, along with significant electrical power. During normal operation, the complete system draws about 50 watts in a 24-hour period from the 28-volt *Mir* power bus, but can draw as much as 300 watts in two hours during high-power transmissions. The SAFEX gear can be commanded for frequency and mode changes by the cosmonauts, or remotely operated by ground stations in Russia (R3K in Moscow) and Germany (DFØVR in Oberpfaffenhofen).

A digital voice recorder and digital voice identifier system are included, along with a 9600-baud TNC (Terminal Node Controller) for packet operation. Appropriate filters are incorporated for the repeater and crossband modes. A 2 meter transceiver is not part of the current system, but will be installed for later crossband work.

The primary radio unit is the 430 MHz repeater with a 2.2 MHz offset between input and output frequencies. It can also be used for two-way contacts with those on *Mir*, or as an AX.25 packet digipeater, still with the 2.2 MHz split between uplink and downlink frequencies. A laptop PC can be connected to the SAFEX 70 cm unit for mailbox operation when in the packet mode. The packet system will also be used to send pictures from *Mir* using a special file format compatible with a new software version of JVFAX, currently in development. A digital camera is used to get an image that is subsequently stored in the laptop, and then transferred to the TNC.

During the first days of the SAFEX-II operation, the digital recorder was used to send a voice message on an FM downlink of 437.925 MHz. Early repeater operation required the use of CTCSS (Continuous-Tone, Controlled-Squelch System—also known as "PL" or Private Line) tones to activate the repeater on the uplink frequency. The tone used in July was 141.3 Hz, also known as EIA (Electronic Industries Association) code 4A. While this tone setting can be changed, it may become the standard for future operation. Refer to **Table 1** for uplink and downlink frequency details.

The second radio unit includes a crossband linear transponder with a 1265 MHz input and a 2410 MHz output. While use of the 70 cm system is geared more toward "normal" ham operation, the L/S-band system is an experiment designed to test techniques that may become more prevalent on future manned missions. The microwave transponder is 10 MHz wide and uses an IF (Intermediate Frequency) in the 70 cm band. This bandwidth is capable of passing high-speed data or even television signals. The ATV (Amateur TeleVison) group at the University of Bremen was tasked with the design and construction of many of the L/S-band components. The wide bandwidth of the transponder is sufficient to pass most AM or FM ham TV signals. For narrowband signals, however, the Doppler shift will be a problem. At 2410 MHz, a signal can exhibit over 100 kHz of apparent drift from AOS (Acquisition of Signal) to LOS (Loss of Signal) during an overhead pass. SSB (Single Sideband) or CW (Continuous Wave) operation will be a REAL challenge.

"Many stations have had successful contacts through the FM repeater in space using only handie-talkies and 'rubber-duck' antennas."

Finding *Mir*

The best way to track the *Mir* space station is to use a tracking program on a computer. Software can usually be purchased or found on various BBSs, via the Internet. A good source of quality programs is through AMSAT, the Radio Amateur Satellite Corporation. You can call for information at (301) 589-6062. Access via the World Wide Web can be found at http://www.amsat.org. A simple

Timeline	Downlink	Offset	Uplink
Start of Pass	437.960	-2.22	435.740
	437.955	-2.21	435.745
Closest Point	437.950	-2.20	435.750
	437.945	-2.19	435.755
End of Pass	437.940	-2.18	435.760

Table. 2. Doppler-correcting Mir repeater frequencies (MHz) for ground use.

alternative is to set a dual-band (2 meter and 70 cm) radio or scanner to listen on 145.55 MHz and 437.95 MHz. The 2 meter simplex frequency has been active for many years, and the 70 cm frequency is the *Mir* SAFEX-II repeater output.

Working the SAFEX-II repeater

At 70 cm frequencies, Doppler shift is a serious consideration for NBFM (Narrow-Band FM) work. The apparent receive frequency at the beginning of a pass will be as much as 10 kHz higher than expected. At the end, it will be 10 kHz lower. To get into the repeater, compensation must also be applied to the uplink signal.

Using the published uplink and downlink frequencies, effective communications can only be achieved through the repeater when the *Mir* space station is at its closest point to the observer. At all other times during the pass, corrections must be made to hear the repeater output and to get into the receiver.

Doppler shift is a result of the relative velocity of a moving object with respect to an observer. For a horizon-grazing *Mir* pass it will be at a minimum. For an overhead pass it will be at a maximum. Most new tracking programs allow the inclusion of a specific frequency for Doppler calculations. Use 437.95 MHz if your program has this option. It will provide data on what to expect when the space station comes over.

While listening at a higher frequency at the beginning of a pass, it will be necessary to transmit lower than expected to get into the repeater. For example, if the repeater signal is heard best on 437.96 MHz (rather than the published 437.95 MHz), the appropriate uplink will be on 435.74 MHz (rather than on 435.75 MHz). This correction will change during the pass. Continuously modifying the repeater offset in the radio during a 10-minute pass can be difficult. If your UHF transceiver has memories that can be programmed with different repeater offsets or input/output frequencies, an easy alternative is possible.

"The SAFEX-II system was developed to allow ham radio activity without constant intervention by orbiting hams."

In a typical 70 cm HT or mobile rig, with tuning increments of 5 kHz, program five different memory locations with appropriate receive frequencies and repeater offsets. Don't forget to include the 141.3 Hz CTCSS (PL) tone. **Table 2** is a list of five receive frequencies and suitable transmit offsets that will take care of the Doppler corrections needed during any pass. Simply tune for the best audio quality, and the programmed offset will provide the proper uplink frequency to center your signal in the *Mir* repeater receiver.

The SAFEX-II system will provide much more than just a high-flying repeater. With the high-speed packet and ATV-capable microwave transponder many experiments and exciting activities are possible. The German and Russian groups will be exercising the different subsystems in the months to come, and unlike a typical hamsat, there's someone always nearby to hit the reset switch, pull the covers off, or just pack the gear up for shipment back home for any needed repair. 73

CARR'S CORNER

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Calculating Antenna Bearings

If you're a DXer who uses a directional antenna, especially a yagi or quad beam (which are unidirectional), then it might be nice to know the direction in which to point the darned thing. The trick is to know the *great-circle bearing* between your location and the DX location. That bearing can be calculated with some simple spherical trigonometry using a hand-held calculator or a computer program. Before talking about the math, however, we need to establish a frame of reference that makes the system work.

Latitude and longitude

The need for navigation on the surface of the Earth caused the creation of a grid system to locate specific points on the surface of our globe. **Figs. 1** and 2 show how this system works. *Longitude* lines (**Fig. 1**) run from the North Pole to the South Pole. The reference point (longitude zero), called the *prime meridian*, runs through Greenwich, England. The longitude of the prime meridian is 0 degrees. Longitudes west of the prime meridian are given a plus sign (+), while longitudes east of the prime are given a minus (-) sign. If you continue the prime meridian through the poles to the other side of the Earth it has a longitude of 180 degrees. Thus, the longitude values run from -180

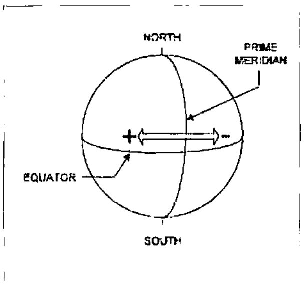

Fig. 1. Measuring longitude.

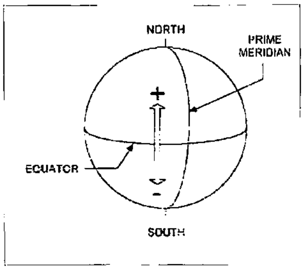

Fig. 2. Measuring latitude.

degrees to +180 degrees, with ±180 degrees being the same line.

The observatory at Greenwich is also the point against which relative time is measured. Every 15-degree change of longitude is equivalent to a one-hour difference from the Greenwich time. To the west, subtract one hour for each 15 degrees, and to the east, add one hour for each 15 degrees. Thus, the time on the east coast of the United States is -5 hours relative to Greenwich time. At one time, we called time along the prime meridian *Greenwich Mean Time* (GMT), also called *Zulu time* to simplify matters for CW operators.

"The great-circle bearing between your location and a DX location can be calculated with some simple spherical trigonometry, using a hand-held calculator or a computer program."

Latitude lines are measured against the equator (**Fig. 2**), with distances north of the equator being taken as positive, and distances south of the equator being negative. The equator is 0° latitude, while the North Pole is +90° latitude and the South Pole is -90° latitude.

Long ago, navigators learned that latitude can be measured by "shooting" the stars and consulting a special atlas to compare the angle of certain stars with tables that translate to latitude numbers. The longitude measurement, however, is a bit different. For centuries sailors could measure latitude, but had to guess at longitude, often with tragic results. In the early 18th century, the British government offered a large cash prize to anyone who could design a chronometer that could be taken to sea. By keeping the chronometer set accurately to Greenwich Mean Time, and comparing GMT against local time (i.e. at a time like high noon, when the position of the sun is easy to judge), the longitude could be calculated. If you'd like to learn more about this subject, most decent libraries have books on celestial navigation.

The great circle

The shortest distance between two points is a straight line, right? Nope, not on a globe. On the surface of a globe, a curved line called a *great-circle path* is the shortest distance between two points. This path can cause some interesting anomalies. For example, I live on a latitude that is close to the latitude of Lisbon, Portugal (in which case, why do *they* get the good weather?). Given that fact, one might assume that I would point my beam due east, at a bearing of 90° from true north. If I did that, I might hear Portuguese voices coming over the receiver, but they would be from the west coast of Africa, close to Angola (a former Portuguese colony).

Fig. 3 shows the basic problem of calculating antenna bearings. Consider two points on a globe: A is your QTH, while B is the other station's QTH. The distance D is the great-circle path between A and B.

The great-circle path length can be expressed in either degrees or distance (as miles, nautical miles or kilometers). To calculate the distance, it is necessary to find the difference in longitude (L) between your longitude (LA) and the other guy's longitude (LB): L = LA - LB. Keep the signs

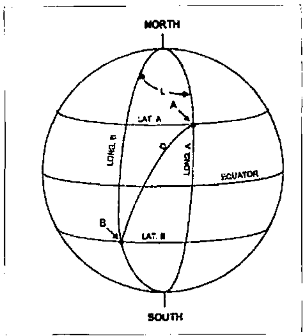

Fig. 3. The great-circle path.

straight. For example, if your longitude (LA) is 40°, and the other guy's longitude (LB) is -120°, then L = 40 - (-120) = 40 + 120 = 160. The equation for distance (D) is:

$$\cos D = (\sin A \times \sin B) + (\cos A \times \cos B \times \cos L)$$

D is the angular great-circle distance;
A is your latitude;
B is the other station's latitude.

To find the actual angle, take the arccos of Equation 1, i.e.:

$$D = \arccos(\cos D)$$

In the next equation you will want to use D in angular measure, but later on you'll want to convert D to miles. To do that neat trick, multiply D in degrees by 69.4. Or, if you prefer metric measures, then D times 111.2 yields kilometers. This is the approximate distance in statute miles between A and B.

To find the bearing from true north, then work the equation below:

$$C = \arccos\left[\frac{\sin B - (\sin A \times \cos D)}{(\cos A \times \sin D)}\right]$$

The problems

Now for the rub: This equation won't always give you the right answer unless you make some corrections.

The first problem is the "same longitude error," i.e. when both stations are on the same longitude line. In this case, L = LA - LB = 0. If LAT A > LAT B, then C = 180°, but if LAT A < LAT B, then C = 0°. If LAT A = LAT B, then what's the point of all these calculations?

The next problem is found when the condition -180° ≤ L ≤ +180° is not met, i.e. when the absolute value of L is greater than 180°, ABS(L) > 180°. In this case,

either add or subtract 360 in order to make the value between ±180°:

If L > +180, then L = L - 360
If L < -180, then L = L + 360

One problem seen while calculating these values on a computer is the fact that in BASIC the sin(X) and cos(X) cover different ranges (see **Fig. 4**). The sin(X) function returns values from 0° to 360°, while the cos(X) function returns values only over 0° to 180°. If L is positive, then the result of Equation 3, bearing C, is accurate, but if L is negative then the actual value of C = 360 - C. I ran across this problem when trying to compare the results of calculations from New York, NY (40.43N, 77W), to Japan and points in Australia. I had expected some bearings in the northwesterly direction because of the great-circle map published in older editions of the *ARRL Antenna Book.* Oops! After doing a bit more research, I found the error and added the test below to my program:

```
IF L < 0 then
L = 360 - L
Else L = L
End if
```

Another problem is seen whenever either station is in a high latitude near either pole (±90°), or where both locations are very close together, or where the two locations are antipodal (i.e. on opposite points on the Earth's surface). According to Hall (1973), the best way to handle these problems is to use a different version of Equation 3 that multiplies by the cosecant of D (i.e. csc(D)), rather than dividing by sine of D (i.e. sin(D)).

I have a Visual BASIC 4.00 program for calculating the bearing and distance, but the listing is not suitable for printing here. An executable version will be available soon, so contact me for price and availability if you want a Windows© program for calculating bearings.

Acknowledgment: My thanks to the ARRL Technical Department for aid in locating Hall's article, as well as other material on the problem of bearing calculations.

Connections

I can be reached via snail mail at P.O. Box 1099, Falls Church, VA 22041, or via Internet E-mail at carrjj@aol.com.

Reference:

Jerry Hall, K1PLP (1973). "Bearing and Distance Calculations by Sleight of Hand," *QST*, August 1973, pp. 24-26.

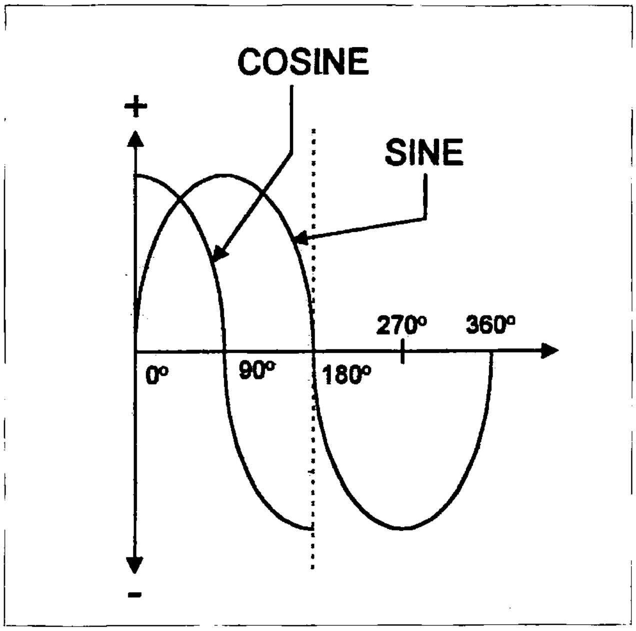

Fig. 4. Sine and cosine ranges.

Never Say Die

Continued from page 51

work at the 3rd International Conference on Cold Fusion (ICCF-3) in Maui in 1993. Dennis is now working with Jim, helping him to develop his cells.

With most of the world pretty well discovered, today's pioneers are in the high-tech fields, bringing us cellular radio, packet, personal computers, and such.

Getting back to colloids. I ran into these first with my reading in the health area. It seems that colloidal silver is a miracle remedy for many problems. It's very easy to make. You merely put a couple pure silver wires in distilled water, add a little pure salt to make it conductive, and then pass a small current through it. In minutes you have a silver colloid solution. How much voltage does it take? 28 volts is fine (four 9V batteries).

I'm reading all I can on the use of silver colloids for health purposes and, when I get some time, I'll have a booklet available for anyone interested.

What's a colloid? It's particles of metal so small that they remain suspended in a solution and don't sift out when left undisturbed. We're talking very small particles, just a few molecules each. That's why there is such an enormous surface area for the cold fusion reaction.

Will it be Jim and Dennis demonstrating a cell generating 10,000 watts next year with one watt of drive, or you? How's your pioneering spirit? Have you ever had a desire to go where few have gone before? The threshold of the unknown isn't as far away as you think. I've been privileged to be good friends with several of our ham pioneers—Sam Harris W1FZJ who did pioneering moonbounce work and invented the parametric amplifier was a very good friend. As was John Williams W2BFD, the pioneer of radioteletype, Jack Babkes W2GDG with narrowband FM, and Wes Schum W9DYV with sideband.

The frontiers today are no farther away than they were a century ago. But instead of Africa, Tibet and reaching the poles, they're in digital voice, spread spectrum, cold fusion, and the

Continued on page 59

Number 56 on your Feedback card

Ham to Ham

Your Input Welcome Here

Dave Miller NZ9E
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As *73's* "Ham to Ham" column begins its second year with this issue, I'd like to take just a moment to express my thanks for all of those contributors who've sent in their tips, suggestions, and ideas ... the meat and potatoes that keeps the column going and growing. I'm always looking for more, so don't hesitate to offer your own ideas to the list. There's a lot of information this time, so let's get right to it.

Lighten up

From George Vaughn WA4VWR: "I've found a local source for the bulbs that illuminate the Kenwood TS-940's subdisplay. When one of them went bad in my TS-940S, I removed both and measured the voltage applied to and the current drawn by the single working bulb ... 12 volts at 75 milliamperes. A trip to the local Radio Shack™ store resulted in my discovering standard RS replacement bulbs of the exact size and shape (RS Cat. #272-1092), but the RS bulbs draw 15 mA less, or 60 mA—and they lack the little green 'bootie' that the original Kenwood bulbs have. The 'bootie' can be carefully removed from the old bulb (provided it hasn't been cooked into place), and, with the aid of a touch of clear silicone grease, can be installed on the RS replacement bulb quite easily.

"The 15 milliamp difference in current (and light output) is about the same as if one were to put a 47 ohm, 1/2 watt 'bulb-life-extending resistor' in series with the Kenwood bulb, so to me it's perfectly acceptable. The biggest difference is in the price: $1.49 for two of the RS bulbs vs. $4.19 for each of the Kenwood replacements ($8.38 total) plus $6.00 shipping. That's $7.19 per bulb from Kenwood, 75 cents per bulb from Radio Shack. Guess which ones I'm using in the future.

"What about the TS-940S's 'S-meter' bulbs ... does Radio Shack carry a replacement for them? Yes, but this time the difference is more pronounced. The bulbs in the S-meter are 12V at 75 mA; the Radio Shack replacement with wire leads (Cat. #272-1141) is rated at 12V but this time at only 25 mA. It's noticeably dimmer than the stock Kenwood bulb, but it may be acceptable to many; you'd have to try it and see. Personally, I chose to use Radio Shack's Cat. #272-1143, a 12V, 75 mA bulb, but with a screw-in type of base. If you use the same bulb as I did, it's advisable that you not solder the 12 volt feed wire directly to the screw-type base, but rather wrap a couple of turns of non-stranded, fairly stiff wire around the screw-threads instead. Also, be sure to connect the 'ground' 12 volt feed wire to the screw-base, not the 'hot' wire. If the screw-base on this bulb were to ever cut through the insulating grommet, you might damage your set if the hot 12 volt lead were connected to it and then shorted the supply bus to ground. You can easily determine which feed wire is 'hot' and which is ground by measuring each with a voltmeter when the set is turned on. The 'hot' wire will have 12 volts on it and, of course, the ground wire won't. Again, make sure that the ground wire connects to the screw-base shell of the replacement bulb. The tip of the replacement bulb should be reasonably safe to solder the 'hot' 12 volt lead to, using the existing 'solder-blob' as a connection point ... do it quickly.

"One other small caveat: The #272-1143 bulb is just a tad too large to fit into the existing holes in the back of the TS-940S's meter, but a few seconds with a tapered reamer will result in the right hole size for a nice fit; take your time and don't get carried away! If done properly, the original Kenwood bulbs can still be used later on if desired. By the way, it is necessary to remove the metal meter mounting bracket to perform this particular step, but again, the cost savings are well worth the small extra effort."

Moderator's note: We've all noticed how difficult it's become to change the pilot lamps inside most of today's radios. In the old days, when both radios and lamps were a lot bigger, changing a pilot lamp was a pretty straightforward, easily accomplished job . The lamp was always mounted in a socket, and usually a twist of the wrist popped it right out. Not so today; most are now on small wires, soldered in place and buried deep within the wiring of the front panel. It usually requires some internal "surgery," so many hams either don't bother changing them at all when they burn out, or they leave the job for when the set has to be disassembled for some other troubleshooting reason. George has offered some well-thought-out advice in his tips from above; here's some more for you to consider.

More on lamps

What follows won't make the task of bulb changing any easier, but it just might double or triple the time between pilot lamp failures. When a lamp does burn out, many probably think first of going back to the manufacturer for a replacement. There's nothing wrong with that idea, especially if it's a very specialized type of bulb. But, as George pointed out, it's probably the most expensive and time consuming route to take, especially when there may be a much more cost effective approach. Since Radio Shacks stock a number of small, low voltage lamps, many of which will either fit directly or can be adapted to fit, a bit of "ham innovation" is sometimes needed, as exhibited in George's piece.

Take a look into what Radio Shack calls their 12V micro-lamp, Cat. #272-1092. It may well work as a replacement bulb for LCD displays and other situations where a very small size lamp is in order. Hobby stores also carry what they call "grain-of-wheat" lamps, which are very similar, but be sure to ask about their voltage and current ratings. By the way, using a lamp rated at a higher voltage is fine, as long as it will provide enough brightness once it's installed; in fact, it will last a lot longer than one rated at the nominal voltage. Additionally, if you lower the voltage to a 12V lamp, even by just a couple of volts, you'll increase its life dramatically. I've seen test curves that prove that the life expectancy of a lamp zooms upward as the voltage across it goes down, and vice versa of course. Putting a resistor in series with each lamp you replace will often give you two to three times the life expectancy from a given bulb, everything else being equal.

There are three things to consider before doing this: what value resistor will be needed; what its wattage rating should be; and how much loss of light is acceptable. Lowering the voltage to the lamp will decrease its brightness—and shift its color toward the red region—so you'll have to judge visually whether you can accept these consequences.

You can install the lamp, clip-leading a resistor in series with it, then looking at the meter or display under normal room lighting, to see if it's OK for your own particular situation. To arrive at the right resistor values, simply use Ohm's Law, plugging in the correct numbers for your own transceiver's lamp supply:

- Voltage drop desired divided by the lamp's rated current equals the resistance needed.
- Voltage drop desired times the lamp's rated current equals the resistor's wattage.

By way of an example, let's take the Radio Shack #272-1092 lamp that I mentioned before, which has a current rating of 60 mA or .06 amps. Let's say we'd like to drop the 12 volts feeding the lamp down to 10 volts, or a 2 volt total drop. We plug in the numbers:

2 (volts) divided by .06 (amp) equals 33 ohms;

2 (volts) times .06 (amp) equals .12 watt.

Now we know that we'll need a 33 ohm, 1/4 to 1/2 watt resistor in series with each lamp in order to drop the 12 volt lamp supply down to 10 volts. A 1/2 watt

resistor will provide a four-times-safety margin for heat dissipation (dissipation ratings for resistors generally assume their full lead length in free air, so it's safest to over-rate them by two to four times for shorter lead lengths and operation within confined enclosures).

By the way, try to avoid using bulbs intended for flashlight service; they're often high brightness, low life expectancy. There are charts available showing life expectancy at rated voltages for various lamp type numbers. The lamp's manufacturer can provide this information and it's also sometimes included in the more complete electronic supply house catalogs. It's surprising how much different lamps do vary in their average life expectations.

Don't "nit-pick" on Alinco!

Last month I gave you some tips on how to improve the Alinco DR-1200T's static discharge resistance with improved grounding. There are usually ways to improve upon just about any radio made. I'm not trying to nit-pick on Alinco, it's simply that I've become fairly familiar with this rig and feel comfortable attempting some "improvements."

This month I'll show you how you can make the internal CPU "reset" push-button accessible from the front panel. I'd be very interested in seeing submissions from readers on modifications that they've made to this and other popular radios; please just make sure that your tip is reproducible and that it doesn't create any "hidden" problems of its own. Obviously, I can't test all tips submitted to me for the column, since I don't have access to every rig on the market ... wish I did!

The Alinco DR-110T and DR-1200T/TH (and perhaps others in this line) have a hardware CPU reset push-button switch located just to the right (when viewed from the front) of the "Call/Call W" switch, but it can only be accessed from inside the radio, when the front plastic cover is removed. There's also a software reset (described in the owner's manual) that involves holding in both the "F" and "VFO/M" keys at the same time and turning the "POWER" switch on and off. But what if that doesn't correct your problem? The hardware reset switch actually momentarily grounds the reset pin on the CPU and should clear any conceivable programming error—at least anything that's curable by restarting the microprocessor.

It's an easy matter to add access to this hardware reset switch the next time you have the radio on your workbench. Simply drill a small hole (1/8" or so should do it) between the "Call/Call W" switch and the microphone connector. The hole should be carefully drilled from the inside to the outside (in fact, there exists a small "starter" hole inside the plastic front panel, as if they intended to make the switch accessible, then changed their minds). The finished hole is barely noticeable against the black background of the front panel itself, but it will give you access to the momentary hardware reset switch. Just use a thin, insulated probe to access the switch, should the CPU ever go bonkers and require a complete, non-maskable reset. Resetting the CPU will erase all memories and other user-defined data from the radio, but at least it will get you quickly back to "ground zero" again for reprogramming (you have a written copy of all of your programmed entries, right?).

Here's another quick tip for the same model of transceiver, in the spirit of the lamp tips mentioned earlier. If you don't want to go directly to Alinco for replacement display bulbs, I've successfully used Radio Shack's #272-1092, 12 volt, 60 mA "microlamps" as replacements. Chances are, they'll fit in other brands of transceivers as well for easily obtained replacement purposes, but always check for excessive heat buildup and too much current drain anytime you decide to substitute for a manufacturer's original part.

Short fuse

From John Ayers AA1IC: "It's often recommended by transceiver manufacturers (and others) that a mobile amateur transceiver's 13.8 VDC supply come directly from the vehicle's battery terminals, with a fuse or circuit breaker as close to the battery itself as possible (as opposed to simply picking up a feed from a convenient 'existing' battery voltage point somewhere under the dash). This practice will often cut down on the amount of noise introduced by the vehicle's electrical system into the ham rig, as well as minimizing RF interference from the ham gear getting back into the vehicle's computer or other RF sensitive electronics.

"Though the practice is strongly recommended, the hardware needed to accomplish it isn't always easy to obtain. For several years now I've been keeping my eyes open for the 'ideal' hardware to accomplish this job—something with adequate current capability and feed wire size, ease of physical mounting, and also suitably enclosed to prevent premature environmental-exposure failure. I've run across an automotive automatic circuit breaker at a local NAPA auto parts store that I feel meets these criteria. It's small, is rated at 20 amps DC, comes equipped with 10-32MS connecting studs, has husky mounting ears, and is fully enclosed against the elements (something we have to think about in our Vermont winters!). The one I chose is part #CB6317 and sells for under $6 including tax. If physical mounting within the engine compartment isn't practical in your installation, there is also an in-line model (without the mounting ears) that could be slipped inside a short length of PVC pipe (or other insulated covering) for added protection."

Moderator's note: If you're not able to find the circuit breaker that John mentioned locally, try obtaining a catalog from Parts Express, 340 E First Street, Dayton, OH 45402-1257 (513-222-0173 or 1-800-338-0531 for orders). They stock a variety of circuit breakers, fuse blocks, high-quality battery clamps, side mount posts, and other accessories needed for mobile audio and radio installations. They also carry the heavy primary wire (as large as No. 4 gauge), in any footage quantity desired, for extending your transceiver's cabling

right up to the battery itself. As John pointed out, you can often automatically avoid many mobile noise/interference headaches simply by using a "dedicated" radio 13.8V battery run ... or even a dedicated separate battery. A "clean" battery feed source (without random noises generated by other devices) is always the first step in any mobile installation noise elimination "foxhunt."

(Ed. note: Remember that the breaker must be mounted as close to the battery as possible for maximum protection.)

Net topics

From William Thim N1QVQ: "On some of our area repeaters, we have both general check-in nets and newcomer nets these days. But a group of us, N1TDW, N1SPJ, KD1ZV, and myself, came up with the following idea a while back. Why not have a local 'expert' net night when possible? We discussed it with the repeater owner, and he went for it enthusiastically and without hesitation.

"Basically, we encourage hams in the area with expertise on some particular aspect of ham radio to give an informal 20- to 30-minute talk on a subject in which he or she is experienced, followed by an appropriately timed question and answer session. Examples of subjects might be packet, satellite communications, the ins and outs of amateur TV, antenna construction and installation, weather nets, HF data modes, etc. The list is nearly endless since ham radio has so many interesting facets. The topics don't even have to be purely amateur radio: someone in broadcasting or emergency rescue could also keep a group riveted with a description of their profession and some of their interesting or off-beat experiences on the job.

"Start by suggesting one 'expert night' per month, then have the other area nets announce it on their own net night, repeaters and PBBSs and see if it doesn't increase your list of check-ins and 'future-ham SWL' listeners alike."

Power astray

From Jack VanGilder N3MPS: "My VHF packet station consists of a Kantronics KPC-3 TNC, in conjunction with a Kenwood TM-241A 2 meter FM transceiver. Both are powered by a 13.8 VDC external supply ... not an uncommon current-day setup. One day, however, my TM-241 wouldn't release from the transmit mode, was emitting a low-pitch tone, and the KPC-3 TNC became very hot to the touch.

"I immediately shut everything down and began to investigate. I discovered that the small coaxial power plug that supplies the 13.8 VDC to my KPC-3 had worked its way loose, pulling out just far enough to allow the 'normally closed' contact on the sleeve of the power jack to 'make' before the tip of the plug had broken its contact. I had installed the alkaline back-up batteries in the KPC-3, so the full 13.8 volts was placed across them by this unfortunate set of circumstances. The batteries apparently built up substantial internal heat and pressure, rupturing their seals and allowing their corrosive electrolyte to leak out into the TNC itself.

"What to do? I first applied some baking soda and warm water to the area affected, allowed it to neutralize any acids present, then cleaned the circuit board as best I could with a sponge and more fresh warm water. After permitting it to dry thoroughly, I was elated to find that everything was now working again. However, not wanting a repeat performance, I then made sure that the tip of the external power plug would disengage before the sleeve's normally closed contact had the chance to switch back as the power plug was slowly removed. It's probably also a good idea to remove the batteries whenever the unit is operated from an external power supply, as well as to insulate the battery terminal connector so that it can't come into contact with anything that it shouldn't inside the TNC.

"The lesson learned? Beware of those little coaxial power connectors (and others) that permit 'automatic' power transfer switching. Make sure that they 'break' before the other connection 'makes.'"

Moderator's note: Jack brings up a good point, and one that has the potential of creating problems in many other pieces of equipment. Any power connector that allows the "normally closed" contact to close before the external tip connection is completely broken is a candidate for the type of problem that Jack describes. This could be any item, from your daughter's portable stereo to your own telephone answering machine. Better put it on your list of things to check out; I know I have. Depending upon the actual circuitry of the device, you might be able to install a diode in series with the internal battery feed, with the diode's anode toward the positive battery output. This would permit current to flow only from (not to) the battery pack (you'll lose about 0.6 volts across a silicon diode, but that may not be consequential—you'll just have to give it a try and see).

Simply floored!

From Bob Boehm N8EXF: "Operating mobile, whether HF, VHF, or UHF, can be very challenging today with the smaller automobile interiors and plastic dashboards!

"I ran into a problem of where to mount my Kenwood TS-440S/AT in my Dodge 4x4 ... either the gear shift was in the way, or I couldn't reach the radio's controls! I solved the installation problem by building my own custom floor-mounted bracket out of Stanley™ brand preformed channel pieces from my local home improvement center. They come in various lengths and in 90-degree angles, allowing you to fabricate just about any kind of custom-fitted mobile floor mount that you might need.

"In the case of my own TS-440S, I used one 18" channel, cut it in half, and bolted a 90-degree 'T' section to each half. This formed the 'base' that was then bolted to the floor. Next, with two pieces, each 10" long, the vertical uprights were formed, onto which the mobile mounting bracket for my TS-440S was attached. The completed installation resembles an upside down 'T' when viewed from the side (see **Fig. 1**).

"It's withstood life in a 4x4 very nicely and the controls of the radio are within easy reach of the driver, without cramping anyone in the passenger's seat—the perfect solution in my own case. Perhaps this same idea can

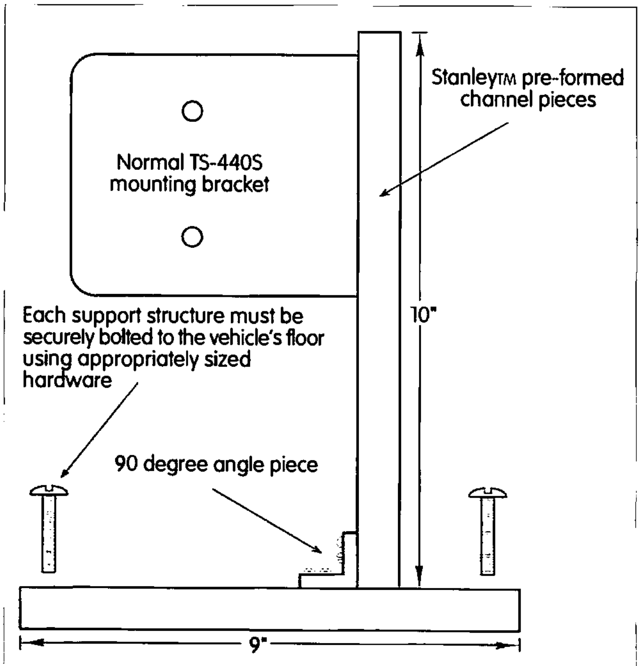

Fig. 1. Side view of N8EXF's idea for a home-brew floor mount to better position his Kenwood TS-440S HF transceiver in his Dodge 4x4. Two identical sections are needed, spaced to accommodate the standard Kenwood mounting bracket for this radio.

be adapted to solve your mobile installation woes as well."

Cable tie rip-off

In order to keep long lengths of coax cable, audio cable, power cable, etc. from tangling up when coiled, many hams use electrical tape around the cable coils when storing or transporting them. Tape works, of course, but it usually ends up leaving an unwanted gooey residue on the cable as well. Tape has a limited number of uses before it no longer adheres to itself, and, naturally, it's often lost when the cable itself is uncoiled for use. Fortunately, there is a much better solution, thanks to modern "fastener science."

The half-inch-wide sew-on Velcro™ material—not the self-adhesive variety—makes an excellent, permanently re-usable cable tie if the simple dimensions shown in **Fig. 2** are followed. Various lengths of Velcro are usually available in craft or fabric stores; just ask your XYL for her suggestions. As everyone knows, Velcro has two parts, a "fuzzy" soft-surfaced loop strip, and a "pinchy" harder-surfaced hook-strip. I'll just call them "fuzzy" and "pinchy" for easier identification purposes.

To make a single cable tie, cut about 6" of "fuzzy" Velcro and about 1" of its "pinchy" counterpart, place a few drops of household "super" glue (of the type containing cyanoacrylate ester) on the backside of the smaller "pinchy" piece, then place the two pieces back-to-back and squeeze them together securely between a couple of pieces of scrap aluminum, using a long-nose pliers, hemostats, or a vise, letting the glue cure.

Next, punch one or two small holes (a leather belt punch works nicely for this) into the free end of the "fuzzy" strip, large enough to pass a small, thin plastic cable tie-wrap (I use the 1/8" wide by 4" long #T18R plastic tie-wraps). These are the type of plastic tie-wraps sold in most electronic stores for permanently tying bundles of cables together, but in this case, it will be used to permanently fasten your new "Velcro tie" to the cable you're working with ... roughly 6" back from the cable's connector is generally about right (doubled-over waxed cable lacing twine also works nicely in place of the plastic tie).

Once the Velcro tie is fastened to the cable at the right point, with the plastic tie-wrap or lacing twine, just coil the cable up as you normally would. Once it's completely coiled, wrap the new Velcro tie—"fuzzy" side up—around the coil and press down on the "pinchy" strip to lock. Pull on the "pinchy" strip to unlock the tie. You now have a permanent, re-usable, always-close-at-hand cable tie system. A small "starter line" painted across the very end of the "pinchy" strip will tell you at a glance where to rip it open.

Make up as many ties as you'll need for all of your cables (including those on your power tools) and you'll thank yourself each time you use them ... it's a great rainy day or cold weather indoor construction project. Different colors of the Velcro material can be used to make up different colored "Velcro ties" for easy identification of different cable lengths or connector types.

Feel free to vary the dimensions shown in **Fig. 2** to accommodate smaller or larger cable coils. The dimensions shown seem to work well for "average" coils, so it's best to start by using them (at least until you're more familiar with the idea), then you can "customize" to your heart's content. By the way, don't steal your XYL's Velcro supply; I know the consequences of *that* mistake!

To UTC or not to UTC?

From Ken Guge K9KPM: "Many hams prefer to keep their station logs in UTC time, as opposed to local area time. It often makes QSLing much easier, since the DX station will probably use UTC time in his or her log (the use of UTC time seems to be much more popular with hams in other countries than with those of us here in the U.S.).

"One of the problems in using UTC time is the change-of-date that occurs at UTC Midnight. Here in North America that happens several hours before our local date-change; we sometimes forget about that fact. If you're going to be consistent in your log-keeping, the UTC date change must also occur at the correct point in time, yet none of the UTC clocks I've seen take that factor into account.

"My Timex Indiglo™ watch, however, does. It has two time display options: one for local time and date, another for an optional time and date. If UTC time is programmed into the optional display, the date will also be correct (on that display) following UTC Midnight—so the correct time and date for UTC are always just a 'touch of a button' away. You might want to take a look at these watches (and perhaps others with the same option) the next time the kids ask what you'd like for your birthday. Dads who are hams are easy to buy for!"

Two different worlds

In today's two worlds of electronics, analog and digital signals

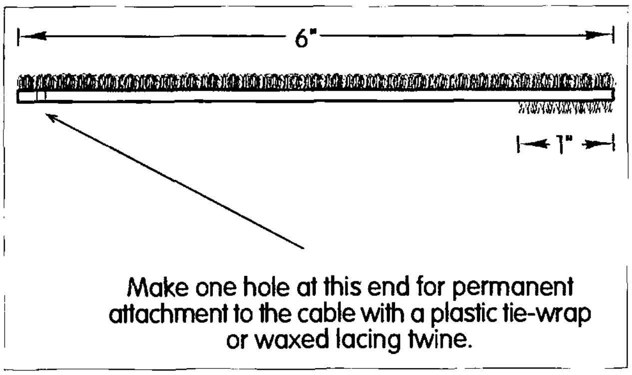

Fig. 2. Side view of NZ9E's home-brew Velcro™ cable tie.

NEVER SAY DIE

Continued from page 55

investigation of other anomalies of science. They're in rediscovering lost or buried past developments in health and other fields, such as the work of Royal Rife, which should be reopened. Ditto Wilhelm Reich. There are some amazing things happening with magnets. Just reading some of the books on my list of books you're crazy if you don't read will open all sorts of pioneering opportunities to anyone with imagination and curiosity. Whole continents of science are still there to be discovered. Which will you be prouder of 10 and 20 years from now, having watched Murphy Brown or some ball games, or having helped pioneer a new technology? This stuff doesn't take formal education—indeed, that seems to be a drawback when it comes to original thinking. It doesn't take a lot of brains either. What it takes is the same thing success at anything takes: persistence. That's what sets life's winners apart from the rest of us.

Beware The NSA

A reader sent me a copy of a couple articles from *Health Freedom News* that got my attention. The first was a reprise of the work Dr. Robert Becker reported in his fascinating book, *Cross Currents*. I've reviewed that book in a past editorial, but I didn't get you to read it. I'd hoped to get at least a few readers fired up enough to start experimenting with ways to regrow missing body parts through the use of low voltages.

The second part had to do with a friend of the author who had built a chamber which shielded a person totally from all electromagnetic fields. He put in antennas to detect the very low levels of frequencies given off by living creatures, then built a wideband amplifier to amplify the body emissions and then feed them back at a high level to get positive feedback. He found that animals could tolerate the treatment for about 30 seconds. He found the results to be amazing. The animal's genes and cells which are programmed for aging and death seemed to be reset backwards.

He found that three treatments a week apart was able to rejuvenate old and maimed cats and dogs. The next-door neighbor's dog, for instance, had been hit

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must coexist, often side-by-side, on the same circuit boards in our receivers, transceivers and data controllers, yet the two varieties of signals are often mutually incompatible. Steep-wave-fronted digital data signals are often the most troublesome culprits in this coexistence battle, impressing "digital noise" of various kinds onto the more "peace-loving" analog signals. It's a problem that electronic circuit designers are continually fighting (and overcoming for the most part). Here are some of the proven techniques that they use.

Obviously, keeping digital and analog circuit components as far apart physically as possible is the first step, though not always entirely practical in today's crowded circuit board environment. But where it is possible, it's best to follow that axiom. Keeping parallel-running circuit traces or harness wiring with digital pulses and analog signals away from each other is also important. "Noise induction" is often the cause of crossover between those two worlds. Shielded cabling can help, even for circuitry that doesn't normally call for shielded wires. Multi-layering of boards, with digital and analog signals one above the other, is another source of cross-induction problems; sometimes shielding in the form of aluminum sheet-stock between the two can help in this area. Just make sure that any shield-planes are grounded only to their respective ground buses. This implies that digital and analog grounds and ground planes should also be separated from each other on the PC board(s), and they should be as large as possible to provide the least amount of resistive voltage drop (since that's where problems can sometimes begin). The use of separate positive power supply traces for the digital and analog portions of the circuit is also almost a must; make sure that all digital chips are powered only from the digital power bus and all analog chips or transistors are fed only from the analog feed point. A common power supply for the digital and analog circuits is usually possible, but separate plus power and ground leads to each separate power bus on the board itself is considered to be good practice. Using separate output regulator chips from a common power supply can also offer some noise crossover protection. Working to avoid ground loops, where the resistive loss in the loop can act as a development point for crossover noise, should be taken into consideration. If it's possible to ground coax cables on one end only, many potential problematical ground loops can be forestalled before they develop. Lastly, but certainly not leastly, generous numbers of bypassing capacitors, on both the analog and particularly the digital, power buses can save countless hours of troubleshooting and head-scratching later on. Bypass caps are inexpensive; use them freely.

Hopefully some of these tips may prove useful to both amateur digital circuit builders and circuit troubleshooters alike, since they can usually apply to both ends of that scale. It's often a mistake to assume that every precaution has been carefully observed in every manufactured item of ham equipment ... there's often lots of room for improvement. Just ask any dyed-in-the-wool equipment modification aficionado!

In closing

One closing note: Many thanks to Tom Miller WA8YKN (314 S. 9th. St., Richmond IN 47374) for allowing me to "beta test" his new "micro-sized" Bioelectrifier, the original circuit of which was first described in *73*, May 1996 issue, beginning on page 10. Tom did a beautiful job of reducing the circuitry, board size and battery compliment to their smallest common denominators. His revised schematic diagram is shown in **Fig. 3**. Tom also informed me that FAR Circuits (18N640 Field Court, Dundee IL 60118) is offering his board (only the PC board), and that Tom himself is offering a kit of parts and completely wired and tested units (less the enclosure). Contact FAR Circuits for the basic circuit board and Tom for the semi-kits (at the addresses above) ... asking for a current price list. Also always include a self-addressed and stamped envelope (SASE) when corresponding with those who have been thoughtful enough to offer us these boards and kits ... their margins are often too low to allow them to pay for the postage to answer our questions! Also, remember that the Bioelectrifier is for experimental purposes only, for enhanced plant-growth studies, and that it has no governmental approval for any other experimental use (does water have governmental approval for human consumption? I'm not sure).

This ends another month of "Ham to Ham." As mentioned in the beginning, we're now into our second year of the column and hope to go on much, much longer. Many thanks to the folks at *73* for making "Ham to Ham" possible. A special thanks to my principal proofreader and general guru of the often impractical English language, Sue Miller KA9UCK, and to Joyce Sawtelle of the *73* staff for her helpful support.

I still need your continued input to keep the column interesting. Send your ham-related tips, ideas, suggestions, and shortcuts to the address at the top of this column and share your findings with the rest of the *73* readership. They don't have to be "earth-shattering" or "cutting-edge technology" brainstorms ... just ideas you've found to be practical and helpful to you in your everyday amateur radio experience. Hope to hear from you soon. 73, de Dave, NZ9E.

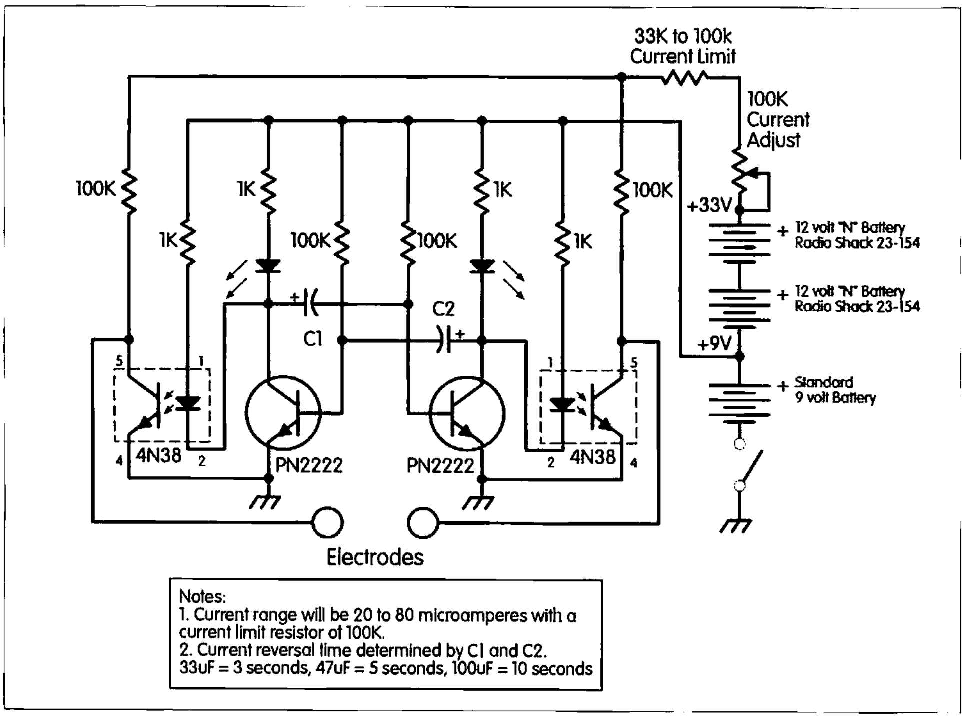

Fig. 3. *Tom Miller WA8YKN's revised and reduced Bioelectrifier, originally featured in the May '96 issue of* 73.

• Murphy's Corollary: "All matter will be damaged in direct proportion to its importance to the end-user."

Many thanks to this month's contributing readers...specifically:

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Note: The ideas and suggestions contributed to this column by its readers have not necessarily been tested by the column's moderator nor by the staff of *73*, and thus no guarantee of operational success is implied. Always use your own best judgment before modifying any electronic item from the original equipment manufacturer's specifications. No responsibility is implied by the moderator or *73* for any equipment damage or malfunction resulting from information supplied in this column.

Please send all correspondence relating to this column to *73's* "Ham To Ham" column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles, IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

☐ **VR2ET** Fiji

☐ **VR2FD** Fiji

☐ **FO8AS** Tahiti

☐ **5W1AZ** Western Samoa

☐ **W2NSD/KS6** American Samoa

NEVER SAY DIE

Continued from page 59

by a car some years before and a hind leg crushed so it had to be amputated. And there was spinal cord injury. The dog's hair was graying and falling out, it was overweight and had trouble breathing. Three months later the hind leg had regrown, the spinal damage healed, the dog's hair had grown back (now black) it had lost the excess weight, and was breathing normally. It was young again.

The physicist returned home a few days later to find the National Security Agency (NSA) cleaning out his papers and laboratory. They explained that he had no say in the matter. A few days later his house and lab were burned to the ground.

The NSA is twice the size of the CIA and operates both in and out of the US. It monitors phone and radio communications worldwide. All long distance phone calls and faxes are subject to monitoring by the NSA.

Now, if the above isn't total baloney, and I have no reason to suspect it is, maybe it's about time you started working on a shielded room and sending me articles on building wideband amplifiers. Considering the progress Becker made, the above isn't completely implausible.

I'm going to track down the author and see if I can get more details.

The article also mentioned a chap who has been working with magnetic fields. He immerses people in a strong field and body regeneration has occurred. One man had a tumor which blocked 90% of his spinal cord, making him a quadriplegic. 104 hours of treatment totally healed the tumor and the paralysis. Another, blind from degeneration of his optic nerve, regained full sight after six hours in the magnetic field.

I've got a good friend who is deeply involved with magnets and magnetism therapy. I'll see what he knows about all this.

Meanwhile, is any of that enough to get you to cut back on your TV and rag-chewing and do some experimenting? Sigh. I thought not. But if you do decide to experiment, keep quiet about it so you or your lab don't suddenly disappear. Well, not 100% quiet. I expect some confidential reports which I'll memorize and burn.

Insurance protection

Skip this section if you have no interest in your or your family's health.

Do HMOs or your company health insurance help keep you healthy? Sure, just as much as fire insurance keeps your building from burning and accident insurance keeps you from having accidents. Well, perhaps that's not an apt comparison since sometimes fire insurance tends to encourage "business fires."

How about doctors and hospitals? They mainly deal with relieving the symptoms caused by illness, and not with helping you avoid illness. No, that's up to you. And, as I've mentioned, your doctor is not one of the first people you want to turn to for advice. An AMA report showed that doctors live an average of 58 years, while the rest of us manage to live an average of 75 years.

Now, would you rather read my grumblings about the ARRL and the FCC, or pass along what I've been learning about how to live longer and healthier? At 74, and with one more average year to live, for some reason I'm paying more attention to maintaining and even maybe improving my body's health. I've got enough projects lined up so I'd like to counterbalance those doctors who died in their 40s by living into my 100s.

Well, I've already outlived "Bud" Budlong W1BUD, the League General Manager for many years. Knew him well. I knew Mort Kahn W2KR well too. He was the architect of the League's so-called "Incentive Licensing" proposal. As the Hudson Division Director he got together with some other directors and pulled a palace coup, where they threw Budlong out (he died soon after) and Kahn replaced him with a puppet, with Kahn pulling the strings from his yacht in Florida.

But you don't want to hear about all that dirty laundry when I could be explaining what I've discovered via one heck of a lot of research about recovering your robust health and preventing any of the normal illnesses such as cancer, heart trouble, arthritis, diabetes, and so on. I'm convinced that all that stuff is completely avoidable. Or, if you've already done the damage through ignorance, repairable.

Identity

There's a strong tendency among our revered "health care givers" to categorize us. Back in the days when I was a licensed professional mental repair technician, I quickly learned never to jump to any conclusions as to what was causing my patients' troubles based on seemingly similar cases I'd worked on with similar problems. The fact is that we're all different mentally as well as physically. And that difference goes right down to some basic levels.

This came to mind as I was reading a fascinating book, *The Pulse Test*, by Dr. Arthur Coca. The book was originally published 40 years ago, and is available in a pocket book 1996 edition. It's 186p, $5, and has ISBN 0-312-95699-1. Yes, it'll be in my next update of my list of books you're crazy if you don't read.

It points out that we're all allergic to different things—foods, dust, pollens, and so on. It also points out that we are probably unaware of our sensitivity to

Continued on page 86

Number 62 on your Feedback card

HAMS WITH CLASS

Carole Perry WB2MGP
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Dayton '96 Youth Forum

There were lots of young adults in the audience at the Dayton Youth Forum this year; therefore, it was a success. The youngsters who interview to be presenters and who spend lots of time preparing their presentations enjoy a responsive, large audience of their peers.

The forum opened up with Maria Lopez, Clifford Uyeda, and the nice folks at Kenwood giving a little pep talk about youth in amateur radio. They also gave away several watches and Kenwood sports bags. It's my rule at the Youth Forum that prizes may be won only by people under the age of 18. This forum is for them!

The speakers

My first speaker was Beth Harris KJ7FC from Cheyenne, Wyoming. She is 15 years old, has an Extra Class license, and is last year's recipient of the ARRL's Hiram Percy Maxim Award. Beth's teacher exposed her to amateur radio in the seventh grade. She showed us a video that she and her teacher put together showing the elaborate satellite tracking station, moonbounce, and AMSAT equipment at the school's radio station. Beth spoke about how knowledge gained from being a ham has helped her in her various school studies.

Ken Fritz N3WAX is a 13-year-old Tech Plus from Glen Mills, Pennsylvania. Ken is active on RTTY and CW and enjoys operating special events stations like the Miss America Pageant and different Boy Scout events. He showed a series of slides from various club activities like Field Day, which he feels provides incentives for children to get involved and to upgrade their licenses. He stressed the importance of local clubs in helping to give newcomers a good start.

Sam Garrett AAØCR is 18 years old and is from Florissant, Missouri. He is the 1991 recipient of the Westlink Report Young Ham of the Year Award. Sam has spoken at several Youth Forums with me across the country in the past few years. He is a most accomplished young man. His speech was about how to use amateur radio to get scholarships for college. The scholarships are available to people of any age who want to pursue post-secondary education. Sam spoke about FAR, Foundation for Amateur Radio, which is a clearing house for administering scholarships for different groups. DARA, the Dayton Amateur Radio Association, has eight awards for $2,000 per year to aid college-bound students. The ARRL Foundation is a large resource for lots of scholarships. Through a single application process, you can gain access to many sources of funds. He also mentioned Chavarim of Philadelphia, which awards money to qualified hams of the Jewish faith. The Radio Club of America has permanent grants in place at several universities and technical colleges across the country. Interested applicants can contact FAR for more details.

Sam also made another good point: Add amateur radio activities to college résumés to show involvement in community activities.

My next guest from industry was Richard Stubbs KC5NSZ, who is the customer service manager for MFJ. Martin Jue, who is the founder of MFJ, deserves a tremendous amount of credit for always being so supportive of educational efforts in amateur radio. He has been good enough to send Richard to several of my youth forums and to make wonderful presentations of radio gear to winning children. The young man who won the MFJ 9420X 20 meter travel radio was in attendance at the Youth Forum in the hope of getting inspiration to become a ham. What better "inspiration" could there be?

Photo A. Carole Perry WB2MGP gets Dayton Youth Forum participants ready ahead of time.

***Photo B.** Left to right, front row: Sam Garrett AAØCR, Beth Harris KJ7FC, Sarah Wisutzkey, Kirk Severson KBØLNM, Ken Fritz N3WAX, Jeremy Graham N9OWS. Back row: Carole Perry WB2MGP, Ben Fenster KBØOVM, Mike Ballbach NØZTQ. Photo by Mrs. Ballbach.*

Jeremy Graham N9OWS, age 14, was next to speak. He talked about the close relationship between various Boy Scouting activities and amateur radio. Different merit badges, like Orienteering, utilize map and compass skills. He told about how valuable he was on a campout when he and some other Scouts were separated from the group. Having the radio with him helped make things a lot easier. Jeremy got a pleasant surprise after speaking—he was called back up to the podium 10 minutes later to receive the prize of an ICOM W31A 2m/440 dual-band radio, presented by Chris Lougee. Chris has given away ICOM rigs at almost every Youth Forum I've run. Let's all remember to support those manufacturers who are supportive of young people in the hobby.

"Sam AAØCR made a good point: Add amateur radio activities to college résumés to show involvement in community activities."

Cathy Lentz KBØFDU is 19 years old and has spoken at my forums before. From Hiawatha, Kansas, she has the distinction of being my first married youth forum speaker. The fact that she's also a busy young mom made her appearance that much more special. Cathy has a starring role in the amateur radio promotional video "Always On The Air" being produced by Bill Pasternak and others. She showed us the first few minutes of the tape. It looks like a winner. Cathy spends time going into local schools to do radio demos for the children. She suggests that many schools require community service of their students, and that teenaged hams might want to look into doing demonstrations as a way of earning this credit.

The last presentation was worth waiting for. Under the guidance of Ellie and Rip Van Winkle from the Boulder Amateur Radio Club in Colorado, the BARC Jr. "Dayton Team" did a round-table discussion, along with a wonderful talk about why their club is so successful with youngsters. The team consisted of chairman Mike Ballbach NØZTQ, 16, with an Advanced license; Ben Fenster KBØOVM, 13, with a Tech Plus license; and Kirk Severson KBØLNM, 13, with a Tech Plus license. Sarah Wisutzkey, a fourth-grader, was the alternate who attended all the meetings with the boys. The team gave the audience at Dayton some valuable information about fund-raising ideas like raffles, donations, loaner radios, and many more creative approaches needed to raise the money for the trip to Dayton for the team. For the last few years Ellie NØQCX has provided me with excellent young speakers for the Dayton Youth Forum. BARC Jr. is lucky to have such dedicated elmers and elmiras to help them out and to encourage them in their amateur radio activities.

The interest of young people going to the Internet is something for all of us to consider. That's one reason these youth forums are so important. We, as adults, the parents and the teachers, have to listen to what the youngsters are saying about what motivates them and what interests them.

Hope to see lots and lots more children at Dayton in '97! 73

Low Power Operation

Michael Bryce WB8VGE
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This is a special 10th-year column. Yup, 10 years of "QRP." It's hard to believe that it's been that long since I started this column for *73*. A lot has happened to both ham radio and QRP in the last decade. Let's look back and then put our sights on the next 10 years.

Personal

When I started this column, there was the ever-popular "Hate Mike Bryce Club." The two primary members were my wife Lynnette and friend Terry. Well, the club folded in 1988. Lynnette left me for Terry and I joined the singles' ranks. And the Hate Mike Bryce Club folded. Two years later, I met a very attractive woman with a passion for the old and unusual. I fit right in so we were married on Field Day of June 1990. Donna and I spent our honeymoon chasing W6s on 40 meters.

While Donna had no interest in radio, and still does not, she delights in the hamfests. Always looking for old radios to repair, I became rather proficient at fixing old tube-type receivers. Between antique clocks, old radios and teddy bears, we have an interesting home! And personally, I wouldn't change a thing.

Clubs

In 1986 when I started this column, there were perhaps three QRP clubs of international fame. They were the QRP ARCI, The Michigan QRP club, and the G-QRP club. Today, all three are alive and well, and all three have shown outstanding growth in their ranks.

Perhaps more important has been the growth of smaller local-based clubs. There are now local clubs in nearly every corner of the union. Here is a short list of some of the clubs that have emerged: The New England QRP Club, NorCal, The NorthWest QRP Club, The St. Louis QRP Club, and The Colorado QRP Club. There's more to the list than I have included; if nothing else, this shows that activity in low power ham radio is growing.

Perhaps the most popular topic I've covered in this column has been building equipment. I've tried to cover the spectrum from easy-to-build to out-and-out stupid! There are several projects that still leave a warm spot in my soul. Here is a quick look at some of my personal favorites.

The Two-Fer

The Two-Fer was a simple VXO-based transmitter that was easy to build. You could assemble it in less than half an hour. With a whopping 1 watt output, the Two-Fer could easily work the world. While most of us assembled the Two-Fer transmitter, there was a matching direct conversion receiver that didn't work worth a hoot.

I don't know how many Two-Fer transmitters were built. I'd guess well over a thousand. To this day, I still get requests for parts kits and PC boards for this project.

As popular as the Two-Fer was (and is today!), there came several improved versions of the basic circuit. Of course, those new and improved Two-Fers were given plenty of space here in the column.

The 6L6 Special

I started this project as something to do on the weekends while Donna worked. It was also the birthday for the 6L6. I built a few tube-based transmitters when I got my Novice ticket way back when, so out came the Greenlee chassis punches and a trip to Perry's QTH. Perry W8AU has the world's largest walk-in junk box!

With its single 6L6 and a 5U4 in the power supply, the 6L6 Special would produce about 10 to 14 watts of RF—if you wanted to be mean. Operation was crystal-controlled on 80 and 40 meters. If you poked, beat and kicked the poor guy, you could manage 20 meters as well. Also, if you pumped the plate voltage up and bolted the little 6L6 down, you could zap out 50+ watts, for a short time.

The mail produced by the 6L6 Special was huge. I got letters from old-timers who'd renewed their interest in ham radio all because of the 6L6 Special. Oh, and then there were the letters from the new hams confused about the dipping and peaking of the 6L6!

> **"QRP does not mean using decades-old circuits; you'll find plenty of microprocessors in our QRP gear."**

I have no idea how many versions were built, but I'm sure the 6L6 Special generated a lot of warm fuzzies for many a ham.

The T/R Switch

One of the first projects to appear in the column, this was very popular with builders. The switch allowed painless interfacing between a QRP transmitter and receiver. It also generated a sidetone and provided a key interface.

On the downside, right after the T/R Switch was published, Radio Shack™ discontinued several key parts. That made the PC board outdated. As popular as the T/R Switch was, I'm planning an updated version. Look for it in the coming months.

The Pulse Charger

This guy started out on a whim. I never expected it to take off like it did. So popular was the Pulse Charger that I redid the original article and produced a PC board. I received requests for boards from all over the world—I even had a small company ask about building the Pulse Charger for commercial use.

There are probably a dozen more projects that were just as popular, but the ones described above seemed to generate the most mail.

Hate mail, farts and fizzles

The column titled "The Oscillator From Hell" generated more hate mail than you can imagine! I guess it was aptly named! To this day, I still get nasty letters about that column.

Continued on page 79

Ham Radio Fun

Number 64 on your Feedback card

Communications Simplified, Part 10

Peter A. Stark K2OAW
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Now that we understand the fundamentals of AM and FM, it is time to look at a typical radio receiver.

Fig. 1 shows the same crystal radio we introduced in Part 6 (*73*, June 1996). We pointed out that it consists of just a few parts:

1. An outside wire antenna, which captures all the various radio signals coming our way.

2. An antenna coil and variable capacitor, which do two jobs. The antenna coil is wired as a transformer, coupling the antenna signal to the radio. The secondary of the coil along with the variable capacitor also form a tuned circuit which selects the station we want, while rejecting stations we do not want.

3. A diode which rectifies the AM signal.

4. A 0.001 µF capacitor which filters out the high-frequency carrier and sidebands, and keeps only the envelope—the audio signal.

5. A pair of headphones which convert the audio signal to sound.

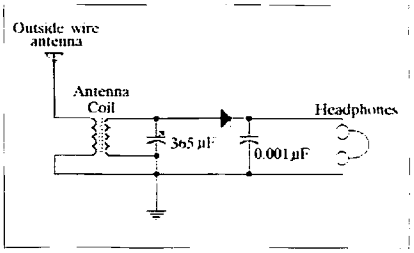

Fig. 1. A simple AM crystal radio.

Variations of this radio circuit date back to the early days of radio. The big advantage, of course, is that it is simple and requires no batteries, but that simplicity carries a price—the radio doesn't work very well. It has poor sensitivity and poor selectivity.

Sensitivity

The term *sensitivity* describes the ability of a radio to pick up weak signals. Our crystal radio has low sensitivity: it can pick up only really strong stations.

Sensitivity has to be judged in relation to noise. Just picking up a station is not enough if the station is so noisy that it is not pleasant to listen to. Spec sheets and advertising literature usually specify receiver sensitivity by measuring how much voltage from the antenna (usually measured in microvolts) is required to make the desired signal (usually the sound out of the speaker) 10 times or 100 times stronger than the noise. This ratio of signal to noise is then called the *signal-to-noise ratio*; a decent radio might provide a 10-to-1 or 100-to-1 signal-to-noise ratio with an antenna signal of under 1 microvolt.

This definition of sensitivity is useful for most radio receivers, but not for a crystal radio. Typical receivers have amplifiers which produce noise when tuned to a weak station, or to no station, so measuring the signal-to-noise ratio is possible. With a crystal set, however, there is really no noise to be heard from the headphones, so measuring the ratio is tough. Still, you need several hundred thousand microvolts of antenna signal to hear anything at all, so sensitivity is clearly bad. The signal-to-noise ratio (and many other quantities as well) is usually measured in decibels, so let us pursue this a bit more.

When we compare two voltages or two currents, the decibel formula is:

$$\text{dB} = 20 \log_{10} \frac{\text{(voltage or current after)}}{\text{(voltage or current before)}}$$

Let's look at a simple example to see how that applies to measuring sensitivity.

Suppose you turn on a receiver, disconnect the antenna (so there is no input signal), and adjust the volume control to get some measurable amount of noise from the speaker. Measure the speaker voltage and call that the "before" voltage. (For our example, suppose it is .7 volts.)

Now connect the receiver's antenna leads to a signal generator, properly adjust its frequency so the radio can receive it, and set the generator output until the receiver's speaker voltage is 7 volts (10 times more than before.) Call this the "after" voltage; it is the voltage needed to provide a signal 10 times stronger than the noise.

Now insert the "before" and "after" values into the formula for decibels:

$$\text{dB} = 20 \log \frac{\text{(after)}}{\text{(before)}} = 20 \log \frac{(7)}{(0.7)}$$
$$= 20 \log 10 = 20 \times 1$$

(since 10 to the 1st power is 10, log 10 is 1). And so the answer is 20 dB.

Now go back to measure the amount of signal coming from the generator into the receiver antenna connection. This value (in microvolts) is the sensitivity to produce a 20 dB signal-to-noise ratio in the receiver output.

Strictly speaking, this is not entirely correct, because the "after" measurement is not just the signal, but also

includes a bit of noise. Hence, many people will call our 20 dB value the *signal-plus-noise-to-noise* ratio, rather than just the signal-to-noise ratio. They may also write it as (S+N)/N, meaning that the signal-plus-noise is divided by the noise output.

Selectivity

Selectivity describes the ability of a receiver to select the station you want, and keep out other stations that you don't want. Our crystal radio has poor selectivity because it has trouble separating nearby stations.

As we've discussed in previous parts, a radio signal consists of a carrier and sidebands, and has a certain bandwidth which depends on the type and amount of modulation. Resonant circuits in the receiver tune in the station you want. Ideally, they should pass all the frequencies in the carrier and sidebands equally well, and completely reject all other frequencies below and above; in reality, however, that is not possible.

DETOUR

At this point, we need to review resonant circuits. **Fig. 2** shows a parallel-tuned resonant circuit of the type most often used in radio receivers. The basic tuned circuit consists of the inductor L and capacitor C, in parallel with each other. An AC input voltage is applied through the resistor R_{in}, and the output connects to a load resistance R_{load}.

If we were to disconnect the L and C, then the input signal would go straight to the output load. Of course, there would be a loss because of current in the two resistors (which make up a voltage divider), so that the output voltage would be smaller than the input voltage. Let's ignore this, though, and just consider the present voltage to be 100%, or the maximum of what it can be, considering the two resistors.

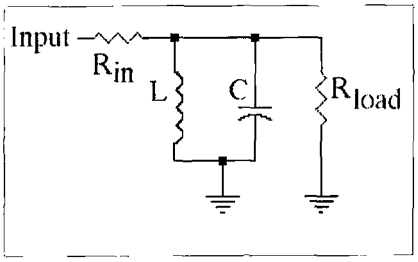

Fig. 2. A parallel-resonant circuit.

When we now connect L and C, there is some current through the inductor L, and also current through the capacitor C; as a result, the output voltage will generally drop. If the voltage drops to 50% of what it was before, we will say that the response of the circuit is 50% or, rather than use percents, we will simply call it 0.5; similarly, if the voltage drops to 80%, we will say that the response is 0.8.

So the response depends on the currents through L and C. There is an important frequency, called the *resonant* frequency, at which the currents through L and C are exactly equal, but opposite in direction—when one current goes up, the other goes down. In this case, the two currents exactly cancel each other out, and it is as if L and C were not there. In other words, at the resonant frequency we get the maximum 100% output voltage; we then say that the response is 1.

"If the superheterodyne receiver had never been invented, communications as we know it would probably not exist."

The resonant frequency is the one at which the reactance of C and the reactance of L are equal; that is,

$$X_C = X_L$$

$$\frac{1}{(2\pi f C))} = 2\pi f L$$

Solving this last equation for f gives us:

$$f = \frac{1}{(2\pi \sqrt{LC})}$$

This is the resonant frequency of this circuit. At this frequency, the output from the circuit is the highest (limited, of course, by the values of the resistors).

As soon as the frequency goes either above or below the resonant frequency, the two currents no longer cancel, and the output voltage drops. The left curve in **Fig. 3** shows the response of this circuit as the frequency changes. We see a peak at the resonant frequency, with a drop above and below that frequency.

Fig. 3 shows the actual frequency response of a tuned circuit at the left, and the ideal response we would like to have

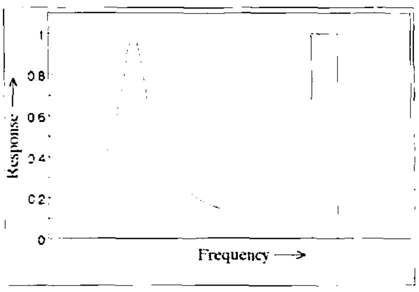

Fig. 3. Actual and ideal resonant response.

for a radio at the right. The ideal response would be a rectangle, where *all* the signals within the bandwidth of the radio signal (carrier and sidebands) get through equally well (the response is 1 or 100%), while *nothing* gets through above or below that range (the response is 0 or 0%).

You can see there is a big difference between what we want and what we get. The ideal rectangular response at the right has:

1. A flat top. This lets the carrier and all sidebands get through the tuned circuit equally well.

2. Steep skirts. The skirt is the vertical part at the left and right. Steep skirts make sure that the response drops very fast, so that no adjacent stations get through.

3. A definite bandwidth. Ideally, this should be just as wide as the bandwidth of the signal we are trying to receive—no more, and no less.

The actual tuned circuit response shown on the left in **Fig. 3** has none of these. The top isn't flat, so the carrier can get through, but the farther out a sideband is, the less of it gets through. The sides aren't steep enough to keep out adjacent stations, since even pretty far away from the peak the curve still has fairly high response. Finally, there is no definite bandwidth to the circuit.

We can flatten out the top a bit by widening the whole curve. The relative width of the curve is determined by a number called the *Quality Factor*, or *Q*, of the circuit.

The Q describes how wide or narrow the response curve is. For instance, **Fig. 4** shows several different response curves with different Q. The higher the Q, the narrower the response is; the lower the Q, the wider it is. You can see

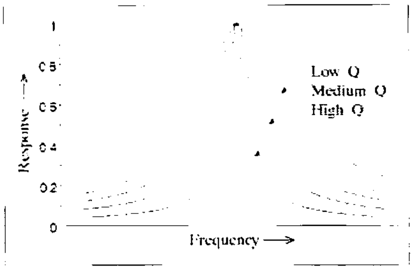

Fig. 4. How Q affects the shape of the response.

that a lower Q would even out the top—but it also widens the bandpass and makes the skirts even less steep.

Fig. 5 shows how the Q is measured. To find the Q, you need two measurements—the resonant frequency and the *3-dB bandwidth*, also often called the *half-power bandwidth*. The resonant frequency is simply the frequency at which the response is a maximum. In other words, it is the frequency of the peak.

The 3-dB or half-power bandwidth is a bit harder to measure. This bandwidth is defined as the difference between the two frequencies where the response drops by 3 dB from its peak value. This also happens to be the point where the output power drops to half of the power at the peak. This needs a bit of explanation.

Look at **Fig. 5**. At the peak, the response has a value of 1. Going down 3 dB from the peak gets us to a response of 0.707 (or $\sqrt{2}/2$, to be exact.) If we insert these values into the formula for voltage decibels, we get:

$$20 \log \frac{0.707}{1} = 20 \times (-0.15) = -3 \text{ dB}$$

In other words, when the response drops to 0.707 of its value at the peak, it has dropped 3 dB from the peak.

This point also happens to be the half-power point. Suppose the output voltage from the circuit is 10 volts at the resonant frequency, and it goes into, say, 100 ohms. Then the power output would be:

$$P = \frac{V^2}{R} = \frac{10^2}{100} = 1 \text{ watt}$$

At the 3-dB point, however, the output voltage drops to 0.707 of its value at the peak, or just 7.07 volts, so the power is now:

$$P = \frac{V^2}{R} = \frac{7.07^2}{100} = \frac{50}{100} = 0.5 \text{ watt}$$

We can use the equation for power decibels to check that 0.5 watt is 3 dB less than 1 watt:

$$10 \log \frac{0.5}{1} = 10 \times (-0.3) = -3 \text{ dB}$$

So back to **Fig. 5**. What we do is to go to the curve, find the two frequencies (one lower than the resonant frequency, and the other higher) where the output drops to 0.707 of its value at the peak, and find the difference between them. This is labeled BW in **Fig. 5**. The Quality factor Q is then defined as:

$$Q = \frac{\text{resonant frequency}}{\text{BW, the 3-dB bandwidth}}$$

The Q is affected by the resistances in the circuit. In **Fig. 2**, the input resistor and the load resistor both affect the Q—the lower the resistors are, the lower the Q. (The resistance of the coil also affects it a bit, but the two resistors have the greatest effect.)

END OF DETOUR

Now that we know some more about resonant circuits, compare **Fig. 1** with **Fig. 2**. The antenna and the primary of the coil in **Fig. 1** feed the signal into the tuned circuit, so their resistance affects the Q. The headphones are the load on the circuit, so their resistance also affects the Q, and, because all of these have fairly low resistance, the Q is terrible! In a typical crystal radio, the response of the tuned circuit is so wide, and the skirts so broad, that it is almost impossible to separate stations from each other. Unless you are lucky to live very close to one radio station and far from all others, don't expect to get very good performance from a crystal radio.

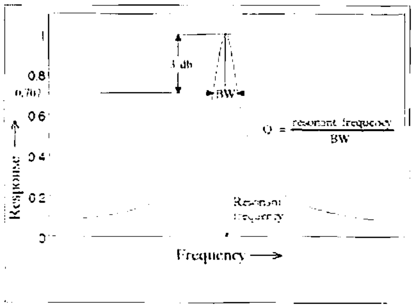

Fig. 5. How to measure the Q of a resonant circuit.

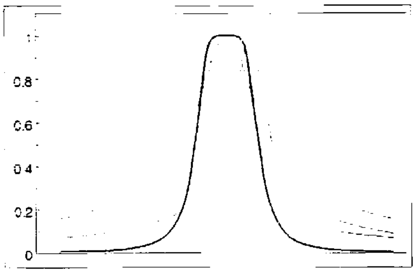

Fig. 6. Improving the bandpass by combining tuned circuits.

How do we improve sensitivity and selectivity?

Improving sensitivity seems fairly simple—just add some amplifiers. Well, it's not quite that simple, because you have to do it just right, as we shall see in a moment, but it *can* be done. Improving selectivity, on the other hand, is somewhat more complicated. There are some modern components, such as crystal or ceramic filters, which can provide a fairly sharp bandpass. The more traditional method, however, is to just add more tuned circuits. For example, the dark curve in **Fig. 6** shows how using three resonant circuits, each tuned to a slightly different frequency and having different Qs, can improve the overall response. There are several ways of getting this same result, and, obviously, the circuit must be carefully designed and set up, or else the resulting bandpass may be lopsided or have lumps in the top.

The problem is that you can't just parallel a bunch of tuned circuits together, as in **Fig. 7**. Even though this looks like three separate tuned circuits, if you parallel the three inductors into one, and the three capacitors into one, you see that there is really only one tuned circuit here. To use more than one tuned circuit in the radio you must somehow separate them so they are not all in parallel with each other. The secret is to separate them with amplifiers.

The TRF or tuned radio frequency receiver

The TRF, or tuned radio frequency receiver, became popular as soon as the

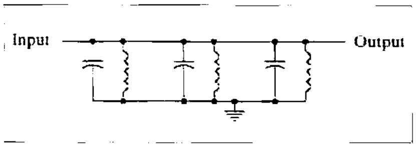

Fig. 7. This is one tuned circuit, not three.

electronics industry got to the point where it was possible to build amplifiers cheaply enough. **Fig. 8** shows the block diagram.

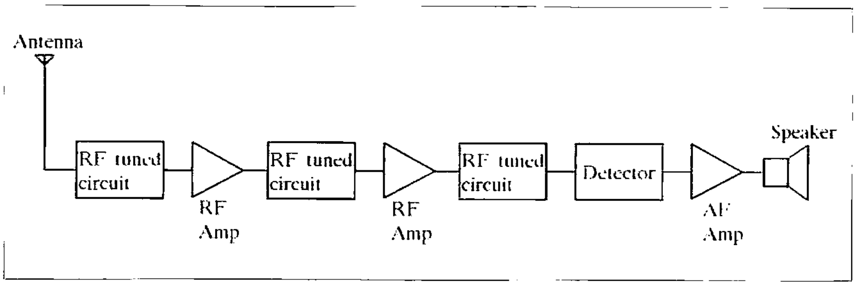

Fig. 8. The tuned radio frequency (TRF) receiver.

The circuit started with an antenna, usually a longwire strung outdoors. Then came two or more RF tuned circuits, separated by RF amplifiers. These were called RF because they all amplified the actual radio frequency (RF) signal. Eventually came a detector, which was simply a rectifier diode and capacitor, that worked just like those in the crystal radio shown in **Fig. 1**. This was followed by an AF amplifier, called AF because it now amplified the audio frequency signal, not the radio frequency signal. The audio signal then went to a speaker. You'll note how RF amplifiers separated the tuned circuits, so they would act separately instead of becoming one single tuned circuit, as in **Fig. 7**.

The TRF receiver worked quite well for its time, but it had some major problems. One difficulty was that each time you wanted to change stations you had to retune all the tuned circuits. Although **Fig. 8** shows only three, some more expensive radios had four or even more. But as **Fig. 6** shows, even three tuned circuits have to be carefully adjusted if you want to get an overall response with a fairly flat top and steep skirts. It was almost impossible for the average owner to get it right.

A second problem had to do with the actual physical construction of the radio. If two tuned circuits were too close to each other, the two inductors would act as a transformer. Some of the amplified signal from one of the later stages would get back into an earlier stage, only to be amplified again and again—this positive feedback made the radio into a perfect oscillator! The more tuned circuits there were, or the more gain the amplifiers had, the worse the problem became. It was really difficult to build a receiver that had both high sensitivity and high selectivity.

Superhet to the rescue!

The solution was the superheterodyne (superhet for short) receiver, invented around 1930. This idea revolutionized radio; all modern receivers use it.

Fig. 9 shows the block diagram. The amplification in the circuit is provided in three separate sections: the RF section, which extends from the antenna to the mixer; the IF section, which goes from the mixer to the detector (and is the main feature of the superhet); and the AF section, which extends from the detector to the speaker.

As before, the RF section contains some RF tuned circuits and amplifiers, which amplify the radio frequency signal. Similarly, the AF section contains some audio amplifiers, and amplifies the audio signal. Between them is the IF or *intermediate frequency* section, which amplifies the signal, but also provides all of the selectivity for the entire radio.

The superhet solves both problems of the TRF design. First, the IF section operates at a different frequency from the RF section; moreover, the IF section stays tuned to the same frequency regardless of which station we listen to. So the tuned circuits in the IF section can be properly aligned in the factory to give the best bandpass curve, and they don't get retuned by the user.

Further, because the overall radio gain is split into three sections, each section's gain is smaller. With less gain, feedback from the output back to the input is less of a problem, and because each of the three sections—the RF, the IF, and the AF—operates at a different frequency, it doesn't matter if a signal from one section sneaks into another, since it just gets rejected.

So the superhet's great feature is that the signal in the IF portion of the radio stays at a constant frequency regardless of what station you tune to. This is done by *heterodyning* or *beating* two signals.

DETOUR

Heterodyning is so important to radio that we have to look at it some more. Consider the circuit shown in **Fig. 10**. We have a box containing some circuitry, and two inputs into the box: one a 100 Hz sine wave, the other a 1000 Hz sine wave. What comes out?

Assuming there is *something* inside the box (not just empty air!), the two input signals will usually, somehow, combine into the output. Electrical engineers will now explain that there are two main possibilities.

If the circuitry in the box contains only resistors, inductors, and capacitors, it is called a *linear* circuit. In linear circuits, the output is proportional to the inputs; there is nothing in the output which didn't come from the input. This is just a fancy way of saying that if 100 Hz and 1000 Hz go in, then only 100 Hz and 1000 Hz can come out.

If the circuitry in the box also contains some diodes, transistors, tubes, or other *nonlinear* components, then this becomes a whole new ball game—things can come out that didn't go in.

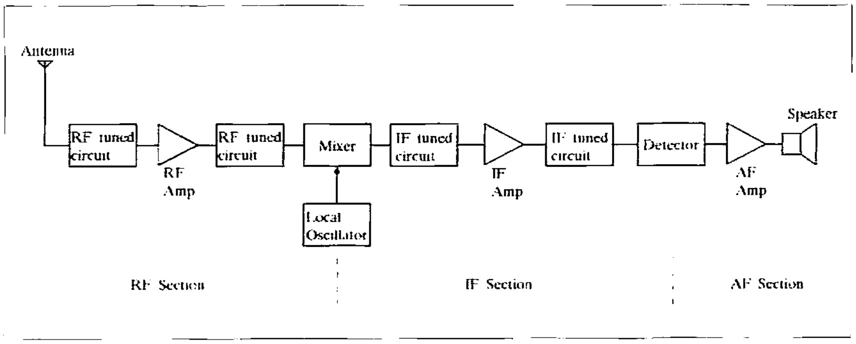

Fig. 9. The superheterodyne receiver block diagram.

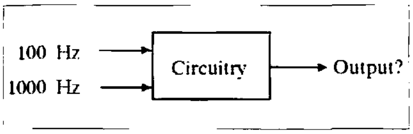

Fig. 10. Mixing two signals in some circuit.

For one thing, nonlinear circuits can distort; they can change the wave shape of the sine waves going in. As we explained way back at the beginning, this introduces harmonics. So the 100 Hz signal could now produce harmonics of 200, 300, 400, or more Hz, while the 1000 Hz signal could now have harmonics at 2000, 3000, etc. Hz.

Much more important for us, though, is that the two input signals can interact with each other. This process is called *heterodyning* or *beating*. When two signals interact like this, they produce new signals whose frequencies are the *sum* and *difference* of the original two signals. In our case, the sum would be 1100 Hz (1000 plus 100), and the difference would be 900 Hz (1000 minus 100). These new frequencies would be called *heterodynes*.

As usual, things are just a bit more complicated. The distortion harmonics also produce sums and differences. For example, the 200 Hz harmonic of the 100 Hz signal could heterodyne with the 3000 Hz harmonic of the 1000 Hz signal to produce 2800 and 3,200 Hz, and so on. Fortunately, the harmonics are usually smaller than the fundamentals, and so these heterodynes are also smaller than the main ones at 1100 and 900 Hz.

At a first glance, you may think this heterodyning is a terrible complication but remember that, without heterodyning, the superheterodyne receiver would be impossible, and radio and TV reception would be a lot worse today.

END OF DETOUR

Let's now see how heterodyning is used in the superhet. As an example, **Fig. 11** shows a superhet AM radio tuned to a radio station at 880 kHz. Coming in the antenna is not just this station, but also signals from all sorts of other stations—radio, TV, radar, etc. The tuned circuits in the RF section remove most of the undesired signals, but not all, so that the signal coming into the mixer is mostly 880 kHz, but still has many other signals.

The mixer is a nonlinear circuit; it receives this combined signal, but it also gets a 1335 kHz signal from the oscillator below it. Since it is nonlinear, it heterodynes these signals. There are a lot of different signals going in so it produces a lot of heterodynes, but the most important ones are the sum and difference of the desired station at 880 kHz, and the oscillator signal at 1335 kHz. This gives us 2215 kHz, the sum, and 455 kHz, the difference.

Note that the tuned circuits in the IF section are all tuned to 455 kHz, so they keep the 455 kHz signal and reject the others. By the time the signal gets to the detector, the filtering has been pretty much completed, and the signal is almost purely 455 kHz (plus the nearby sidebands).

Now, suppose we retune the radio to a different station, say one at 770 kHz. We retune the RF tuned circuits, but these only do a rough job of removing faraway signals; they aren't the main tuned circuits in the radio, so it isn't important to get them just right. But—and here is the important thing to note—we also retune the oscillator to 1225 kHz. The difference between 1225 kHz and 770 kHz is again 455 kHz! So the IF section amplifies the resulting signal, without having to be retuned itself.

The trick when changing stations is to retune the RF circuits (but a slight error here isn't critical), and the oscillator (this is important!) so the difference in frequency between the station you want and the oscillator stays at 455 kHz. Since the RF tuning adjustment isn't that critical, it is possible to use a single knob to adjust all the tuned circuits at the same time, without having to worry about whether all of them are right on target.

In case you wonder why we chose 455 kHz for the IF frequency... well, other values are possible, but this just happens to be a popular one in AM broadcast receivers. FM broadcast receivers usually use 10.7 MHz IF, and other IF frequencies are also used in other kinds of receivers.

If we let $f_{station}$ be the frequency of the station we want, and f_{IF} be the IF frequency, then the oscillator frequency f_{osc} should be:

$$f_{osc} = f_{station} + f_{IF}.$$

But it's also possible to let

$$f_{osc} = f_{station} - f_{IF}.$$

Either way, the difference between $f_{station}$ and f_{osc} is equal to the IF frequency f_{IF} so either will work.

The converter

Many radios combine the mixer and the oscillator into one circuit called the *converter*. This is a popular technique for lowering the radio's cost, because several components in the circuit do many jobs at the same time. **Fig. 12** shows the converter used in many popular AM broadcast radios; there are several useful techniques that are worth mentioning.

L1 and C1 are the RF tuned circuit, with C1 being the tuning capacitor, but L1 does several different jobs. The top part of the winding (above the ground connection) is the part that actually resonates with the capacitor; the bottom part (connecting to C2) acts as the secondary of a transformer, to bring the signal from L1 to the transistor without loading down the tuned circuit (which would reduce the Q).

At the same time, L1 is also the antenna. As we will see later, coils or loops of wire can act as antennas; in this case, L1 is wound on a ferrite core (a ceramic core which contains ferrous metal particles); the core helps to pick up the energy from the radio signal, and concentrate it in the coil.

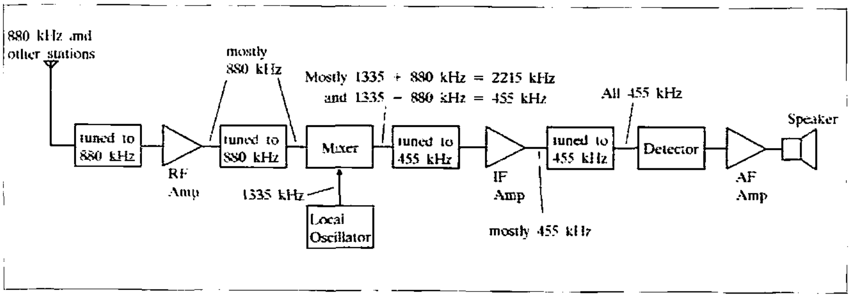

Fig. 11. Superhet with a 455 kHz IF, tuned to 880 kHz.

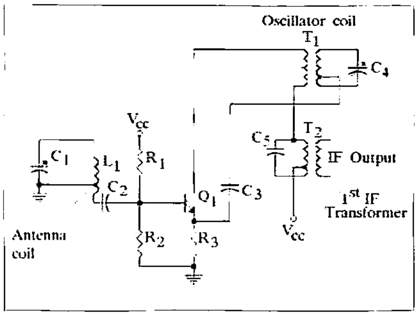

Fig. 12. Typical converter in an AM receiver.

The transistor also does two jobs. First, it oscillates at a frequency 455 kHz above the signal you want to pick up. To do this, we need an amplifier with positive feedback. The transistor is the amplifier, with its output coming out of the collector, going through oscillator coil T1, and back through C3 into the emitter of the transistor. Capacitor C4 resonates with the secondary of this coil to control the oscillator frequency.

At the same time, however, the transistor amplifies the RF signal coming from the antenna coil, and mixes it with the oscillator signal. Because the transistor is nonlinear, it also produces the sum and difference heterodyne frequencies. The primary of IF transformer T2 and capacitor C5 resonate at 455 kHz, and send the 455 kHz difference frequency on to the IF amplifier.

Note how T1 and T2 both use taps on one winding (the tap is a third connection part way into the winding). This reduces the loading on the resonant circuit, and keeps the Q from being lowered.

Variations on a theme

Although **Fig. 9** showed one RF amplifier (with two RF tuned circuits), and one IF amplifier (also with two IF tuned circuits), there is nothing sacred about these numbers. Many cheap radios use only one RF tuned circuit, and no RF amplifier; the converter shown in **Fig. 2** is a good example.

On the other hand, more expensive radios might have more RF amplifiers and/or more IF amplifiers. In fact, quite a few radios use *double conversion*. In this scheme, there are two mixers and oscillators (or two converters), and two different IF amplifier sections. We'll see the reason for this in a moment.

Superheterodyne sensitivity and selectivity

By splitting the amplification into separate sections, a superhet can provide more gain in each section without the danger of signals feeding back and causing oscillation. Further, because the IF amplifier does not need to be retuned each time you change stations, it can be optimized and carefully adjusted at the factory to provide the best possible bandpass characteristics—steep skirts and a flat top. But, there is more to it than that.

Recall our definition of the Quality factor Q of a resonant circuit:

$$Q = \frac{\text{resonant frequency}}{\text{BW, the 3-dB bandwidth}}$$

The 3-dB bandwidth doesn't really specify how well the circuit will reject adjacent stations; in order to reject such interference, the response of the tuned circuit has to be 30, 40, or even more dB down from the top of the curve at the frequencies of any adjacent stations. Still, it provides a useful yardstick for comparison.

"Just picking up a station is not enough if the station is so noisy that it is not pleasant to listen to."

We can rewrite the above equation as:

$$\text{3-dB bandwidth BW} = \frac{\text{resonant frequency}}{Q}$$

To get a small bandwidth, you have to either make the resonant frequency small, or make the Q big, but in most resonant circuits, there is a limit to how big Q can get. It is affected by the resistance of the rest of the circuit, and is seldom more than 20 or 30. So making Q big is not a feasible approach to making the bandwidth small. To get a small bandwidth, it would help if you could make the resonant frequency small.

In a TRF receiver, though, you must tune the resonant circuits to the frequency of the station you want to receive, so you really can't make the resonant frequency small to get a good bandwidth. To further complicate the design, the bandwidth will change as you tune to different stations.

In a superhet, on the other hand, all the selectivity is obtained in the IF stages, and their frequency stays the same for all stations. Moreover, the IF frequency is lower than *any* of the stations you want to receive, so you can get the same narrow bandwidth for every station you listen to. In theory, at least, you could get the bandwidth as narrow as you want, simply by going to a lower IF frequency. (Note how AM broadcast radios, which need a lower bandwidth than FM broadcast radios, also have a lower IF frequency of 455 kHz instead of 10.7 MHz.) But there is a fly in the ointment, as they say—the image.

The image

Let's return to the radio diagrammed in **Fig. 11**. It is tuned to 880 kHz, has a 455 kHz IF, and an oscillator frequency of 1335 kHz. Here we see that 1335 kHz - 880 kHz = 455 kHz.

So far, so good, but suppose there was a station at 1790 kHz. Look at the following calculation:

1790 kHz - 1335 kHz = 455 kHz

In other words, the difference between the new station at 1790 kHz and the 1335 kHz oscillator frequency is *also* 455 kHz. This new radio station could also now be heard, though not as well as the one at 880 kHz because the RF tuned circuits largely remove it. If it were strong enough, though, it would come through anyway. The 1790 kHz frequency is called the *image frequency*.

Note how the image frequency is calculated:

Desired station	880 kHz
+ IF frequency	+445 kHz
Oscillator frequency	1335 kHz
+ IF frequency	+455 kHz
Image frequency	1790 kHz

That is, the image frequency f_{image} is

$$f_{image} = f_{desired\ station} \pm 2f_{IF}$$

(We used the ± sign in the equation because in some radios the oscillator could also be below the desired station

frequency; in that case, the image frequency would be below the oscillator frequency, and we would need the minus sign.)

This brings us to a problem. Just a few paragraphs ago, we said "In theory, at least, you could get the bandwidth as narrow as you want, simply be going to a lower IF frequency," but if you do that, then the image frequency gets closer to the desired frequency, and then the RF tuned circuits may not be able to get rid of it. So you have two conflicting requirements:

To get better selectivity—lower bandwidth—you want to *lower* the IF frequency.

To get better rejection of the image frequency, you want to *raise* the IF frequency.

This is particularly a problem with high-frequency receivers intended to receive narrowband signals. For example, consider an amateur FM receiver for 146.94 MHz. Since the bandwidth of FM signals on this frequency is typically only 10 or 15 kHz, a low IF frequency (such as 455 kHz or even less) would be ideal. But then the image would be at:

$$146.94 \text{ MHz} + (2 \times 455 \text{ kHz}) = 147.85 \text{ MHz}$$

which is not even 1% away from the desired frequency. There is no way that a typical RF tuned circuit could keep the image out—you'd need a tremendous Q to do it.

Typical receivers solve the problem in one of two ways. A few use a much higher IF frequency (around 10 MHz), but with special crystal or ceramic filters which can get the narrow bandwidth even at this higher IF frequency.

A much more common alternative is to use two separate IF sections and double conversion. **Fig. 13** shows the block diagram of a double-conversion superhet to receive 146.94 MHz. Since 10.7 MHz and 455 kHz IF transformers are fairly inexpensive (they are manufactured by the zillions for use in standard AM and FM broadcast receivers), many communications radios use them as well, and we show them here.

To receive 146.94 MHz, the first oscillator runs at 146.94 minus 10.7 MHz, or 136.24 MHz (the oscillator could be either 10.7 MHz *above* the desired signal, or 10.7 MHz *below*; in this case, we chose to use the lower frequency). The second oscillator and mixer convert the 10.7 MHz first IF signal to 455 kHz by using an oscillator at 10.7 MHz + 0.455 MHz, or 11.155 MHz.

By using two IF frequencies, the double-conversion receiver solves our two problems. The high first IF frequency does not provide much selectivity, but it helps to eliminate the image. Since the image frequency is at:

$$f_{image} = f_{desired\ station} - 2f_{IF}$$

(Note that we use a minus sign since the oscillator is below the desired signal, so the image must be even below that.) The image frequency is now:

$$146.94 \text{ MHz} - (2 \times 10.7 \text{ MHz}) = 125.54 \text{ MHz}$$

which is far enough away from 146.94 that the RF tuned circuits can remove it (or at least significantly reduce it).

The second IF frequency of 455 kHz, on the other hand, is low enough so that even transformers with reasonable Q can provide a narrow bandwidth.

Incidentally, suppose we wanted to use a similar circuit to receive 145.015 MHz instead of 146.94 MHz. This circuit would not do, and for an interesting reason: The 11.155 MHz signal from the second oscillator goes into the second mixer, and the mixer is intentionally nonlinear (to produce a heterodyne). Hence, it also generates harmonics of all the signals going in. It turns out that the 13th harmonic of 11.155 MHz is exactly 145.015 MHz. Although this harmonic is weak, a small amount of it will still sneak back into the RF stage and fool the receiver into thinking there is a weak, unmodulated signal at that frequency. Unless your desired signal is substantially stronger than this false signal (called a *birdie*), it will not be heard.

The solution in this case is to change the second oscillator frequency from 10.7 *plus* 455 kHz to 10.7 *minus* 455 kHz, or 10.245 MHz. This new oscillator frequency has harmonics at different places. While this removes the birdie at 145.015 MHz, it introduces birdies elsewhere, such as 143.43 (which is the 14th harmonic of 10.245 MHz). Designing wideband receivers (receivers designed to receive a wide range of frequencies) is always a problem; there are always some birdies somewhere, and the designer has to carefully choose his oscillator and IF frequencies to try to place the birdies at places where they will not interfere with normal operation.

Summary

If the superheterodyne receiver had never been invented, communications as we know it would probably not exist. The combination of features we have described allows radio receivers to have selectivity and sensitivity, letting millions of transmitters around the world coexist with each other while making it possible for us to select and listen to even extremely weak signals from far away.

We have touched on some of the important concepts, yet have had to skip many others. In the next installment, we will try to cover some more concepts having to do with the transmitters and receivers which we run into daily. 73

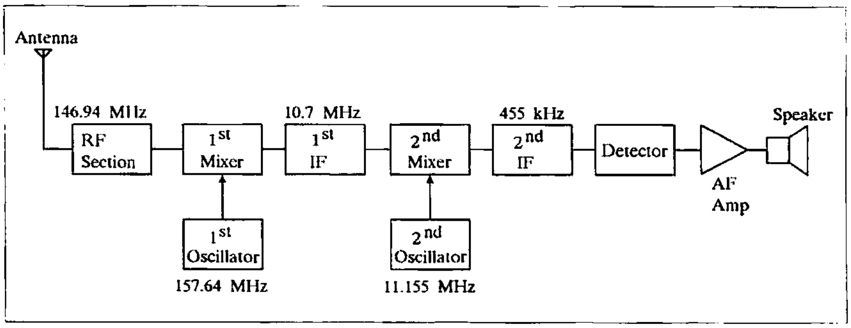

Fig. 13. A double-conversion superheterodyne.

Above & Beyond

VHF and Above Operation

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Pursuit of 2304 MHz: local oscillator and filter

Last month I discussed using a Qualcomm 3036 phase-locked loop (PLL) synthesizer as the backbone for construction in the microwave arena. This synthesizer has enabled our microwave group to construct several converters for different microwave bands, using surplus material, for local oscillator generation. A synthesizer is not perfect, as we stated last month, but it is perfectly acceptable when it's inexpensive and performs well. After all, that's the basic premise for most amateur-related projects: low cost and suitability. After that can come the pursuit of excellence, and gold-plating.

I know that the subject of synthesizers can be a little intimidating but I will try to remove some of the mystique, showing that they can be easily modified. Additionally, the waveguide below cutoff filters that we constructed and used in our transverters will be covered for use at 1296, 2304 and 3456 MHz. I will describe the transceivers that our club members constructed. This was a rush-to-completion project so we didn't use all the bells and whistles. One quick item that was put to use to demonstrate this operation was the filter construction. These filters are not the ultimate, but they are easy and inexpensive to construct and are tolerant of mistakes. This makes a very simple package to assemble with other components to facilitate a microwave converter. Let's cover the synthesizer first.

The synthesizer

The Qualcomm 3036 synthesizer chip is the heart of this circuit. This little chip can directly control a voltage-controlled oscillator (VCO) up to 1.6 GHz by itself, with minimal external circuitry. Equipping it with an additional divide-by-two frequency divider chip (on the PC board) will extend the VCO towards the 3 GHz range. This is the reason the synthesizer that we make available is capable of working directly at 2556 MHz and other frequencies above the 1.6 GHz frequency range of the synthesizer chip.

Other circuitry on the synthesizer board includes the loop filter and clock reference circuitry. The clock used in this application is a very high stability 10 MHz temperature-compensated crystal oscillator, or TCXO for short. The oscillators we use are capable of stability of .1 hertz at 10 MHz or better over temperature.

The 3036 synthesizer chip can be programmed by an IBM 8-bit computer bus, or it can be pin-for-pin programmed in a fixed mode of operation. While the IBM bus mode might be attractive to some serious experimenters wanting to push for other developments, most applications will fall on the basic pin-for-pin manual programming methods that we have developed for single-frequency amateur frequency generation. It is in this fixed mode that all of the amateur frequencies were generated for use at the 2 to 2.7 GHz frequencies for local oscillator use. Multiplication schemes were employed for use at 3456 MHz, 5760 and 10368 MHz. All these schemes used manual pin-for-pin programming.

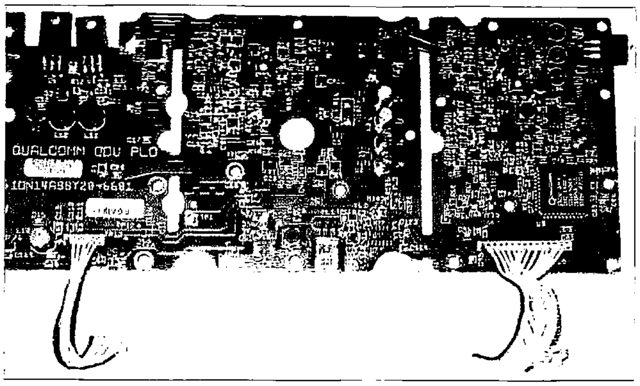

Photo B. Qualcomm power supply synthesizer board before conversion. The left and middle parts of the PC board have been removed, leaving a cigarette pack-size PC board containing all the synthesizer circuitry.

The IF frequency we have chosen to use is 2 meters, making a local oscillator frequency of 2160 required for 2304 MHz. That is, 2160 MHz plus 144 MHz equals 2304 MHz, the operating frequency. Other IF frequencies are possible. The synthesizer as originally used in commercial operation required a frequency of nearly 2.6 GHz and was controlled by an on-board processor (the IBM single-chip 8-bit controller). Pin 22 is the mode select pin of the 3036 chip and is grounded for bus mode and tied to +5 volts for pin-for-pin programming.

Modifying the 3036

Gently cut pin 22 at the board solder trace with a sharp Exacto™ knife and lift the pin from the PC board solder pad nearly horizontal for wiring to +5 volts. In this same manner lift the other pins with the knife to provide for pin-to-pin reprogramming. It might sound difficult, but the conversion is easy; it just requires a delicate smooth operation. A heavy-handed method of operation here will break the pin and render the chip useless.

If you take care and lift the pin with easy slow movements and do not apply force, the pin can be lifted without breaking it. Lift it just enough to allow soldering to the new programming control, which is either ground or +5 volts, as determined by the frequency reprogramming chart shown in **Table 1**. If you are heavy-handed with the knife when lifting the chip pins they will break off and the chip will be gone. Gentle lifting of the pin works well. Do not try to move the pin more than once as it might weaken and break off. Also, don't try to make the pins uniform or "pretty them up," as excessive movement could also break the IC pin off flush with the IC.

Let's discuss the internal structure of the 3036 chip so you can get some idea of just what is going on inside. The Qualcomm 3036 PLL has three counters internal to the chip: the 7-bit "M" and 4-bit "A" pulse swallow counters, and a 4-bit reference counter. All of these programming pins must be configured to our new programming information, along with four control pins (some of the pins are already tied to the correct ground or +5 volt connections and do not have to be changed). **Fig. 1** shows a schematic of the complete assembly.

To modify the synthesizer, you will need a grounded static-free work station equipped with a temperature-controlled soldering iron, an Exacto knife, and a small

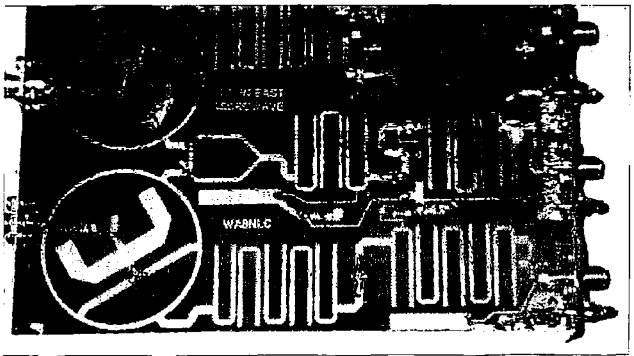

Photo A. 2304 MHz transverter from Down East Microwave, built by Pete W6SAJ.

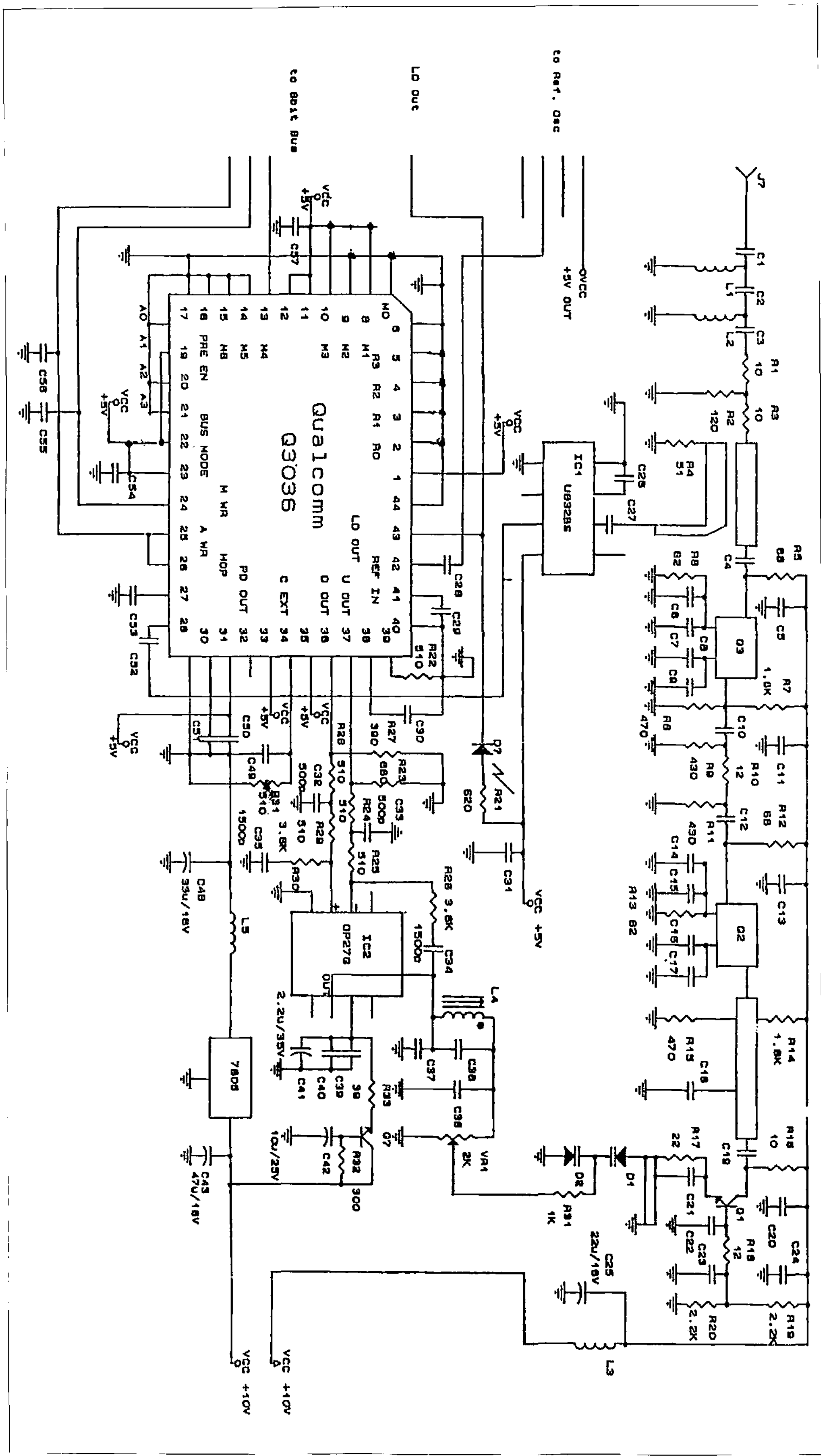

Fig. 1. The Qualcomm 3036 synthesizer chip and its schematic diagram. This was reverse engineered by Kiyotsugi Tanemura JG1QGF.

magnifying lens to examine your progress. The circuitry is quite tolerant to soldering and handling abuse. Don't get me wrong here—I don't recommend mishandling the synthesizer, as it is a high density PC board using very small surface-mount components. It has proven to be quite abuse-resistant, but don't push your luck by mishandling it. Use a temperature-controlled soldering iron that is grounded, and work in a static-free setting. This will prevent static and other voltage-induced problems from damaging chips on the PC board. Do not use a high-heat soldering iron as the excessive heat can lift the PC board copper foil by breaking the bond between the copper trace and the PC board.

To reprogram the 3036 synthesizer chip we used an Exacto knife with a sharp blade and carefully cut the pins of the 3036 (at the PC board) that needed to be lifted to suit our particular reprogramming information. The stock PC board as received was set up for programming by a CPU located on another PC board and connected by the board connector located just above the 3036 chip. (The boards that I make available are pretested by connecting a processor using the stock programming frequency of 2620 MHz.)

In the PC boards that I make available there may be parts of the PC boards that are jumpered around, such as power supply, and other troubles. These "other troubles" have no bearing on the synthesizer operation as most of these trouble spots occur where some of the circuitry has been removed in the modification to amateur frequencies. The cable that connects to the processor is removed along with the processor. This leaves many of the pins of the 3036 open. There are other pins that are tied to ground on the PC board, and some of these need to be lifted and tied to +5 volts. See **Fig. 1** for the pinouts of the 3036 synthesizer chip. **Table 1** shows pin programming for several frequencies commonly used.

The remainder of the conversion consists of reducing the size of the PC board, removing the power and control circuitry that

Q 3036 Pin Assignment/Description

Pin #	Name	I/O Type	Description
1	V_{CC1}	+5V input	Power supply connection
2	R0 IN	TTL/CMOS input	R counter input bit 0 (LSB)
3	R1 IN	TTL/CMOS input	R counter input bit 1
4	R2 IN	TTL/CMOS input	R counter input bit 2
5	R3 IN	TTL/CMOS Input	R counter input bit 3 (MSB)
6	GND	GND	Ground connection
7	M0 IN (DBUS0)	TTL/CMOS input	M counter input bit 0 (LSB), data bus bit 0 (LSB)
8	M1 IN (DBUS1)	TTL/CMOS input	M counter input bit 1, data bus bit 1
9	M2 IN (DBUS2)	TTL/CMOS input	M counter input bit 2, data bus bit 2
10	M3 IN (DBUS3)	TTL/CMOS input	M counter input bit 3, data bus bit 3
11	V_{CC2}	+5V input	Power supply connection
12	V_{CC3}	+5V input	Power supply connection
13	M4 IN (DBUS4)	TTL/CMOS input	M counter input bit 4, data bus bit 4
14	M5 IN (DBUS5)	TTL/CMOS input	M counter input bit 5, data bus bit 5
15	M6 IN (DBUS6)	TTL/CMOS input	M counter input bit 6(MSB), data bus bit 6
16	PRE EN/(DBUS7)	TTL/CMOS input	Prescaler enable input (0=DMP enabled; 1=DMP bypassed), data bus bit 7 (MSB)
17	GND	GND	Ground connection
18	A0 IN	TTL/CMOS input	A counter input bit 0 (LSB)
19	A1 IN	TTL/CMOS input	A counter input bit 1
20	A2 IN	TTL/CMOS input	A counter input bit 2
21	A3 IN	TTL/CMOS input	A counter input bit 3 (MSB)
22	BUS MODE/	TTL/CMOS input	Bus interface control input (0=8-bit data bus, 1=16-bit parallel)
23	V_{CC4}	+5V input	Power supply connection
24	MWR	TTL/CMOS input	Register 1 write input (rising edge active)
25	AWR	TTL/CMOS input	Register 2 write input (rising edge active)
26	HOP CLK	TTL/CMOS input	Hop clock input (rising edge active)
27	VCO IN	Diff ECL input	1600 MHz VCO input
28	VCO IN/	Diff ECL input	Bias decoupling for VCO input
29	GND	GND	Ground connection
30	VCO DIV OUT	ECL output	VCO divider output
31	V_{CCO1}	+5V input	ECL output power supply
32	PD OUT/	ECL output	Phase detector output
33	V_{CC5}	+5V input	Power supply connection
34	CEXT	Analog	External capacitor connection
35	V_{CC6}	+5V input	Power supply connection
36	PD D OUT/	ECL output	Phase detector D/ output
37	PD U OUT	ECL output	Phase detector U/ output
38	V_{CCO2}	+5V input	ECL output power supply
39	REF DIV OUT	ECL output	Reference divider output
40	GND	GND	Ground connection
41	REF IN/	Diff ECL input	Bias decoupling for REF input
42	REF IN	Diff ECL input	Up to 100 MHz REF input
43	LD OUT	TTL output	Open collector lock detector (O.C.=in lock)
44	GND	GND	Ground connection

Table 1. *Pin programming for changing the frequency of the Qualcomm 3036 synthesizer chip.*

is not required. You can prepare the circuit board with modifications first, then cut off portions of the board that are not required.

There is a C2610 +10 volt regulator (TO-220 package) that is part of the power supply circuitry. It can be removed and used to power the modified synthesizer. There are two traces on the bottom of the synthesizer board: a small one and a large wide trace. The wide trace is the +10 volt input to the +5 volt regulator for the 3036 chip. The small trace is the +10 volts for the oscillator amplifier buffer string. Short these two traces together and tie to regulated +10 volts from the C2610 device. On top of the board there are four traces going over the top portion of the board's cutout. Leave this circuitry in place, along with the crystal and chip circuit to the right. On the far right of the 10 MHz crystal filter there is an attenuator pad "T" configuration. This is the 10 MHz reference input. All circuitry to the right and below the 10 MHz filter can be removed.

If you have trouble finding the 10 MHz input pad, start at the far-right part of the PC board before cutting it. There you will find two off-board connections. The bottom one is the +12 volt main input to the power distribution and regulator circuit. The top one is the 10 MHz input and connects directly to this pad to use when you reduce the size of the synthesizer PC board. You might select to leave the PC board intact; that's OK—it's your option whether to have a smaller PC board or keep it at the original size.

General Equations

N = PLL input Freq/Phase Detector frequency

N = 10(M+1) +A

A = N-10(M+1)

R = Reference Frequency (10 MHz)/Phase Detector Freq - 1

PLL input Freq = VCO Freq/2

M = int(N/10)-1

IF Freq	Lo Freq	Phase Detector Freq	VCO Freq	PLL Input Freq (VCO/2)	N	M	A	R
144	10224	2	2556	1278	639	62 (111110)	9 (1001)	4 (100)
448	9920	2	2480	1240	620	61 (111101)	0 (0000)	4 (100)
432	9936	2	2484	1242	621	61 (111101)	1 (0001)	4 (100)

Table 2A. Pin-for-pin programming of the 3036-based PLL synthesizer. As shown in these three examples, the general equations are used to determine the M, A, and R values for a desired IF frequency. These values (in binary form) are hard-wired to the appropriate pins on the IC (see ***Table 2B****).*

1	+VCC	
2	R0	0
3	R1	0
4	R2	1
5	R3	0
6	GND	
7	M0	0
8	M1	1
9	M2	1
10	M3	1
13	M4	1
14	M5	1
15	M6	0
18	A0	1
19	A1	0
20	A2	0
21	A3	1

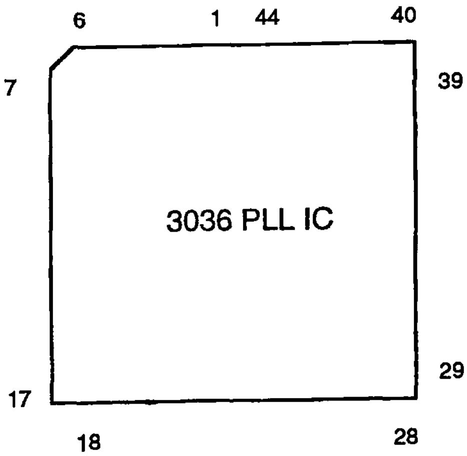

Table 2B. *3036 PLL IC Pinout (top view of chip). The table lists pin designations along with the proper wiring for 144 MHz IF/2556 MHz VCO operation.*

The board can be cut near the bottom cutout where we tied the two traces together, and just above the four capacitors to the right of the top cutout. Cut near the ground foil beneath the PC board traces. You can retain part of the PC board if you desire. This will retain a very good -5 volt bias circuit using a 7660 chip. The other control circuitry is not of interest to an amateur conversion of the synthesizer power supply control board as it was originally built. This conversion removes the essential oscillator synthesizer, reducing of the board real estate to a smaller package. See the accompanying photos for details on the conversion.

Consult **Table 2A** for pin programming information covering a few standard frequencies. Many frequency combinations are possible in the 2.16 to 2.6 or so GHz range using the stock VCO on the board. The board is set up to work with a reference divided frequency of 1.25 MHz. Note that other reference frequencies are possible, such as 2 MHz. All that is required is to reset the "A" reference counter. Before lifting the 3036 pins I suggest you make a paper drawing of your attack plan on how and which pins to lift. (See **Table 2B**.) A little planning in this area will help to familiarize you with the methods of conversion to prevent errors.

When you have lifted all required pins, test each pin for proper DC resistance between either ground or the +5 volt line, as required according to the frequency modification chart, with a VOM. Set the VOM to the X10 scale to verify all pins before and after modification and before applying power. This should bulletproof the modification procedure for errors. When you are satisfied that all is well, connect a source of 10 MHz (1 volt P/P) to the input of the attenuator pad by the 10 MHz filter and apply power. There is an LED phase-lock indicator on the PC board. If all is well it should blink on then off, indicating proper phase lock.

Once you have verified phase lock and output power you can verify output frequency and power. Normally we see about +8 to +10 dBm power output.

Originally we made a modification to the circuitry in the phase detect balance circuit but we found that the circuit is best left alone. Rather, what needs to be done is to modify the output loop filter for the proper values required for the new division divide-by frequency. This loop filter consists of a parallel LC filter shunted to ground with two capacitors. This network is normally set to 1.25 MHz.

The loop filter is converted by changing the filter capacitor component values. To convert it to our new reference frequency add a .001 μF capacitor across the LC filter and add .003 to .004 μF as additional shunt capacitance. The best way to change these values is to piggyback additional capacitors across the existing lower-than-required values. This filter is tied directly to pin 6 of the OP-27 op amp output.

Microwave filter construction

The filter that we constructed for these three bands is an evanescent mode filter, or just call it a waveguide filter below cutoff frequency. It is constructed out of a short section of waveguide of no particular size except for the general rule of thumb: A 10 to 12 GHz waveguide with an opening approximately 1/2"-by-1" is good for the frequency range of 1 GHz to about 3.5 GHz. The filters that I constructed were attempted by selecting components that seemed to suit the frequency of interest knowing the results of my first construction attempt.

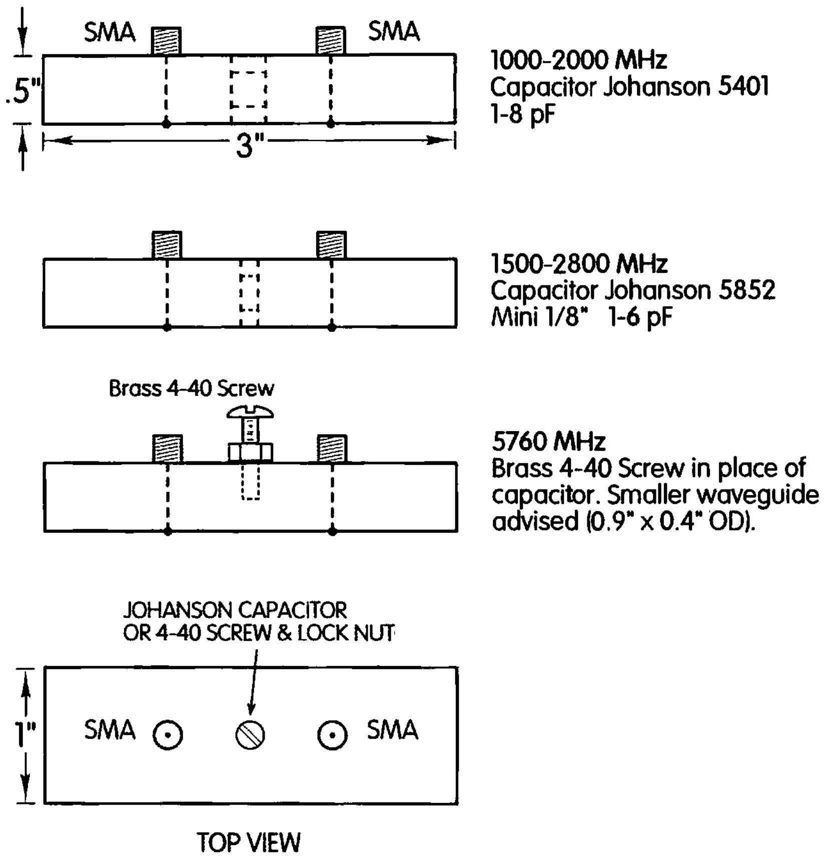

Fig. 2. The 2304 filter using WG-16 1" x 1/2" OD waveguide, and details for other frequencies up to and including 5760 MHz.

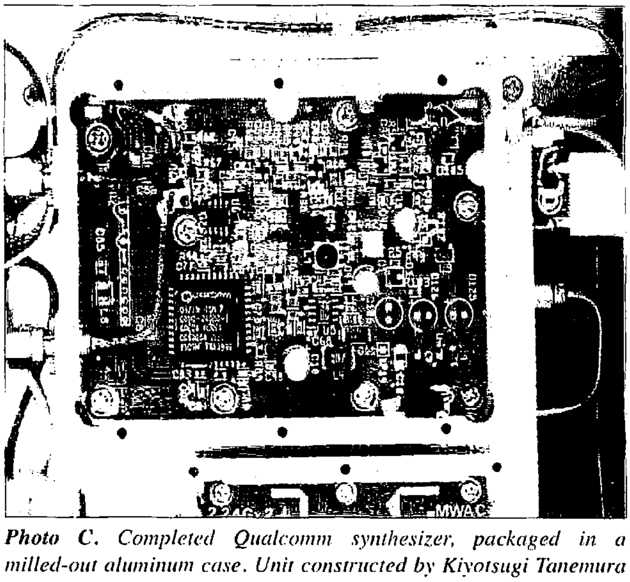

***Photo C.** Completed Qualcomm synthesizer, packaged in a milled-out aluminum case. Unit constructed by Kiyotsugi Tanemura JG1QGF in Japan. This is a premium high-quality conversion that anyone would be proud to have constructed.*

My first attempt was to use a Johanson 5481 1-to-8 pF variable and soldering it between the top and bottom of the waveguide. Coax connectors were spaced 1/2 inch on either side of the capacitor to serve as the input and output ports of the filter. It was no trouble to resonate this filter at 1296 MHz, but the upper frequency was limited to about 2 GHz. Constructing a similar filter but replacing the capacitor with a smaller width (1/8 inch) version of the Johanson capacitor vs. the 5481, which is 1/4 inch wide, made resonance at 2304 and 3456 feasible. Moving on to 5760 was impossible with even the smallest variable I had so we tried a small 4/40 bolt in place of the capacitor. This, while very critical, worked well.

Use a lock nut on the 4/40 bolt (brass nut and bolt) and when it is tuned, lock it with the nut. See **Fig. 2** for the mechanical details. Waveguide rule of thumb: For frequencies in the 1 to 2 GHz range, a waveguide with a 1 inch by 1/2 inch outside diameter is acceptable. For higher frequencies, use the next size smaller waveguide, with dimensions near .9 inch by .4 inch wide.

Well, that's it for this month. I hope that this column is not rushed too much as I am working seven days a week and have little time off for any activities. Pacific Bell, the company I work for, is the prime provider for video operations for the Republican Convention in San Diego and it has me very busy. On another note, I am held up on sending out 30 MHz kits as the supply of TDA-7000 chips is depleted and the new order has not arrived. Please be patient as the orders *will* be filled. Best 73 always, Chuck WB6IGP.

Number 78 on your Feedback card

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 30. Provide a clear, concise summary of the essential details about your Special Event.

SEP 22

MT. HOLLY, NJ The 80th Anniversary of the South Jersey Radio Assn. will be celebrated at Mt. Holly Armory, Rt. 38. The 48th annual Hamfest Computer Show will be held rain or shine, 8 AM–3 PM. Vendor setup 5:30 AM. VE Exams, tailgate sales, seminars. Make checks payable to South Jersey Radio Assn. Inc., and mail with SASE to *Paul E. Hayden KF2YX, 519 North Elmwood Rd., Marlton, NJ 08053.*

OCT 11–13

MESA, AZ The Scottsdale ARC will host the ARRL Southwestern Div. Convention at the Sheraton Mesa Hotel and the Mesa Conference Center. For details, contact *Barbara A. Myers KB7UKD, Exhibit Chairperson. P.O. Box 17108. Fountain Hills AZ 85269-7108. Tel. (602) 837-6492. or FAX (602) 837-6872.*

OCT 12

ALPENA, MI Hincks Elementary School, 7 mi. north of Alpena, on US-23N, will be the site for the Thunder Bay ARC Hamfest. Computer Fair. and North Color Tour. VE Exams at 1 PM, walk-ins okay. Talk-in on 146.76 or 145.49. SASE to *P.O. Box 764, Alpena MI 49707.* For VE info or details, call *Tom K8CHS. (517) 354-2469.*

EVANS, GA The Augusta Hamfest will be held at Evans Middle School. Setup Fri., 6 PM–9 PM; Sat., 6 AM–9 AM. VE Exams start at noon on the 12th. Contact *Richard KR4XN at (706) 860-3828;* or *Rhonda KE4DIM at (706) 560-9600;* or write to *P.O. Box 3072, Augusta GA 30914.*

OCT 12–13

GERMANTOWN, TN MemFest 1996 Greater Memphis Amateur Radio and Computer Show will be held at Shelby Farms Show Place Arena, 105 Germantown Pkwy, Sat., 8:30 AM–4 PM; and Sun.. 8:30 AM–2 PM. RV camping on site. Forums and Non-Ham activities. VE Exams Sat. and Sun. 9 AM–11 AM. Gordon West WB6NOA will be Guest Speaker. Sponsored by the Greater Memphis Amateurs. Exhibitors contact *Mary Moore AC4GF, (901) 758-0661* or *Fax (901) 751-6717.* For Flea Market info contact *Lee Bowers KA4KVW at (901) 867-3461, after 6 PM.* Talk-in on 144.61/145.21 and M9. 17514M. 175.

OCT 13

CHICAGO, IL The Chicago ARC will hold a Hamfest in Oakbrook Terrace IL, 8 AM–3 PM. Setup at 6 AM. Entrance at Park View Dr., north from Cermak Rd. Talk-in on 147.255(+), and 444.825(+). Contact *George, (312) 545-3622; Dean, (708) 331-7764;* or *Cora, (312) 486-6823;* or write to *CARC, 5631 W. Irving Park Rd., Chicago IL 60634.*

LIMA, OH The Lima Hamfest and Computer Show will be held by the Northwest Ohio ARC. 8 AM–3 PM at Allen County Fairgrounds. Setup at 6 AM. Talk-in on 52/52, 146.07/.67, 146.34/.94, and 147.63/.03. To pre-reg. for VE Exams, send complete FCC Form 610. a copy of your old license, a check for $6.05 made payable to *NOARC,* and SASE to *License, c/o NOARC, P.O. Box 211. Lima OH 45802.* For tickets and table reservations, call *(419) 647-6321.* Mail SASE and payment to *NOARC, P.O. Box 211, Lima OH 45802.*

MASON, MI The Lansing Civil Defense Rptr. Assn. and the Central Michigan ARC will co-sponsor a Hamfair, 8 AM–1 PM, at Ingham County Fairgrounds in Mason, MI. Overnight camping available. Trunk Sales space, DX Forum. Vendor setup at 6 AM. Talk-in on 145.390. Contact *Jeff Oberg KB8SXK, (517) 393-4713;* or write to *LCDRA, P.O. Box 80106, Lansing MI 48908.*

QUEENS, NY The Hall of Science ARC Hamfest will be held at the New York Hall of Science parking lot, Flushing Meadow Park, 47-01 111th St., Queens NY. Setup at 7:30 AM, buyers admitted at 9 AM. Talk-in on 444.200 WB2ZZO Rptr., 146.52 simplex. For more info call at night only. *Arnie Schiffman WB2YXB. (718) 343-0172.*

OCT 18–20

CONCORD, CA The Mt. Diablo ARC is host for this year's "Pacificon." The event will be held at the Concord Hilton, 1970 Diamond Blvd. An Antenna Seminar will be held Fri. 8 AM–4:30 PM, pre-reg. required. A Swap Meet will be held Sat. and Sun. 6 AM–11 AM. with seller setup at 5 AM. The seller fee is $10 for both days. There will be Forums. walk-in VE Exams, vendor displays. a Boy Scout Special Events Station, T-hunt, and more, all day Sat. and on Sun. morning. Cynthia Wall KA7ITT will be Guest Speaker at the Sat. evening Banquet. An ARRL Forum will be presented Sun. afternoon. Talk-in on 147.060 + 100. For info, call *(510) 932-6123;* or write to *Pacificon '96, P.O. Box 272613, Concord CA 94527-6125. E-mail: PACIFICON@DESIGNLINK.COM.*

OCT 19

SENECA, PA The Venango Mike and Key Club will hold a HamAuction 8 AM–3 PM at Christian Life Academy in Seneca. Setup at 6 AM. VE Exams at 9 AM. Talk-in on 145.230(-). For reservations contact *Mary Housholder N3QCR. 121 N. Front St., Franklin PA 16323. Tel. (814) 437-2036. Packet: N3QCR@WA3ZCA.#NWPA. E-mail: mahoushold@aol.com.*

OCT 20

CENTRALIA, IL The Centralia Wireless Assn. will host its annual Hamfest at the Salem Community Activity Center, East Oglesby St., Salem IL, starting at 8 AM. Talk-in on 147.27/.87 MHz. Setup for Exhibits and Flea Market will be at 6 AM. For table space and reservations. contact *Daisy King AA9EK, (618) 532-6606.* Mail ticket orders with an SASE to *Centralia Wireless Assn., Inc., Hamfest Tickets. P.O. Box 1166. Centralia IL 62801.*

GOLDEN, CO The 1996 Rocky Mountain Radio League Hamfest will be held 8 AM–2 PM at the Jefferson County Fairgrounds. 15200 W. 6th Ave. Talk-in on 144.62/145.22. The event will feature VE Exams and an ARRL Forum. For info, call *Joe Dickinson WTØC, (303) 771-9577.*

KALAMAZOO, MI The Kalamazoo Hamfest Assn. will present the 14th annual Kalamazoo Hamfest at the County Fairgrounds. Doors open at 8 AM. Trunk sales. Vendor setup at 6 AM. Camping available on site. For more details, call the info hot line at *(616) 657-4482.*

MILLER PLACE, NY "HAMEXPO 96–ARRL Hudson Div. Convention" will be held at the Huntington Hilton Hotel, 595 Broad Hollow Rd., Melville NY. Call *(516) 845-1000* for reservations. The Ham Expo will be open to the public 9 AM–4 PM. Vendor setup at 7 AM. There will be VE Exams and an ARRL Forum. Write to *Radio Central ARC, P.O. Box 680, Miller Place NY 11764. Tel. (516) 399-1877 (Joann N2IME). or E-mail N2MDQ@LI.NET.*

SELLERSVILLE, PA A Hamfest hosted by the RH Hill ARC will be held at Sellersville Fire House, Rt. 152, 3 mi. south of Quakertown and 8 mi. north of Montgomeryville. VE Exams start at 9 AM for all classes. Bring documents. Talk-in on 145.31. Contact *Linda Erdman. P.O. Box 29. Colmar PA 18915. Tel. (215) 679-5764.*

OCT 26

PORT ST. LUCIE, FL The Port St. Lucie ARA "Hamfest–96" will be held 8 AM–3 PM at Port St. Lucie Yacht Club. 500 Prima Vista Blvd. Talk-in on PSLARA Rptr. 146.955 or 146.520 simplex. For table rentals call *Rick Clair (407) 335-1738.* For general Hamfest info, call *Don Metzler (407) 879-4914.*

SALEM, OR The 2nd "SwapToberfest ARES/Races Convention," sponsored by the Mid-Valley ARES, will be held at the Polk County Fairgrounds in Rickreall OR. Setup will be 6 AM–9 PM Oct. 25th, and 7 AM Oct. 26th. Doors will be open for the convention 9 AM–3:30 PM. VE Exams, pre-reg. required; call *Sandy Berry N7TQQ at (503) 585-5924.* Registrations received Oct. 20 or later will be held for pick-up at the door. Emergency Comm. vehicles will be on display from the Oregon State Police, Marion and Polk County Emergency Management, the Civil Air Patrol, and the American Red Cross. For more info. contact *Evan Burroughs N7IFJ. (503) 585-5924.* To download a copy of the flyer and pre-reg. form, surf the net for *http://www.teleport.com/~n7ifj.*

ST. LOUIS, MO The Gateway to Ham Radio Club, and the St. Louis ARC will sponsor the 5th annual Halloween Hamfest at West County Tech. School. Vendors' doors open 4 PM–9 PM Oct. 25th, and 6:30 AM Oct. 26th. The event is open to the public 8:30 AM–2 PM. Flea Market, forums, VE Exams. Wheelchair accessible. For advance tickets, SASE to *Dave NODN, 8370 Latty Ave., Hazelwood MO 63042*. For tables, contact *Keith NØKFE, 8427 Mathilda Ave., St. Louis MO 63123*. Talk-in on 146.34/.94.

ST. PAUL, MN The 12th Anniversary celebration of Hamfest Minnesota and Computer Expo will take place in the main arena at the St. Paul Civic Center, Kellogg & West 7th Sts., St. Paul MN. The event will be sponsored by the Twin Cities FM Club, and will have a huge Flea Market, VE Exams, educational and fun seminars, exhibits, and more. VE Exams and Flea Market setup will take place on Fri. night. Talk-in will be on the 146.16/.76 Rptr. For info and advance reg., contact *Hamfest Minnesota & Computer Expo, P.O. Box 5598, Hopkins MN 55343;* or call *Hamfest Minnesota Info Line at (612) 535-0637.*

SUMTER, SC The Sumter ARA's 10th annual Hamfest and Computer Fair will be held at Sumter County Exhibition Center, 700 W. Liberty St. Contact *Steve Bregger KD4HTS, P.O. Box 52302, Shaw AFB SC 29152-0302;* or *Mike Dunlap KC4HUT, 2763 Tindal Rd., Sumter SC 29150-8830. Tel. (803) 481-4611.*

OCT 27

WESTMINSTER, MD The 7th annual Mason-Dixon Computer & Hamfest will be held at the Carroll County Ag. Center in Westminster, beginning at 8 AM. Setup at 6 PM for vendors and tailgating. VE Exams start at 8 AM, pre-reg. requested; call *Bill Wolfgang NZ3J, (717) 359-7095.* Talk-in on 145.41(-). For inside tables and info. contact *George Johns N3JKY, (717) 632-1621.*

NOV 2

MILWAUKEE, WI The 12th annual "6.91 Friendlyfest" Ham Radio, Computer and Electronics Show will be held 8 AM–1 PM at Waukesha County Expo Center Forum, N1 W24848 Northview Rd., in Waukesha Wi. Vendor setup 5:30 AM–8 AM. Wheelchair-accessible. VE Exams onsite. Bring an original and 2 photocopies of your license and/or CSCE (if any) and 2 IDs, one must be a photo ID. Talk-in on 146.31/.91 Rptr. and 146.52 simplex. Contact *Burt N9VBI, (414) 328-0535* for further details.

TAVARES, FL The Lake ARA, Inc. will hold their Hamfest & Electronic Expo 8 AM–4 PM at the East Lake Chamber of Commerce in Sorrento FL. VE Exams at 10 AM, walk-ins okay. Vendor setup Nov. 1st, 3 PM–6 PM; Nov. 2nd, 6 AM–8 AM. Contact *Tony Summerlin KE4NLG, 9210 Fernery Rd., Leesburg FL 34788. Tel. (352) 360-1380.*

NOV 2–3

ODESSA, TX The 13th annual Odessa Hamfest will be held by the West Texas ARC Sat., 8 AM–5 PM and Sun., 9 AM– 2 PM, at Ector County Coliseum, Exhibit Bldg. C, 42nd and Andrews Hwy. Setup Fri., 4 PM–10 PM, and Sat. at 7 AM. Talk-in on 145.470. Contact *Robert Jordan N5RKN, (915) 335-7980; E-mail N5RKN@aol.com.*

SPECIAL EVENT STATIONS

SEP 21

BADIN, NC The Stanly County ARC will operate K4OGB during the "Best of Badin Festival." Operation will be in the lower General 40m–15m bands and 28.365, all phone. For a certificate, send a 9" x 12" SASE to *K4OBG, P.O. Box 581, Badin NC 28009 USA.*

OCT 1

Walt Disney World, Disneyland, Euro Disney, Tokyo Disneyland, and Capital Cities ABC New York. The parks will be operating on 20m, 40m, 75m, and 2m repeaters from 2230-1700 UTC. Look for them on these frequencies: Disneyland repeaters\146.94, 446, 1282.4—simplex 245.09, 144.3 as W6LPJ; Walt Disney World on a 2m repeater, channel not specified; ABC repeater 147.2 and 144.97 packet; Tokyo Disneyland on 2m repeater; Euro Disney on 440 repeater. Send SASE and QSL for collectable Disney Card.

OCT 12–13

MUSKOGEE, OK The Fort Smith ARC will operate KE5TC 1400–2130 Oct. 12th, and 1600–2130 Oct. 13th, in honor of the "USS Batfish" WWII Submarine. Operation will be on 14.250 and 7.240 phone. Send QSL and an SASE to *Royce Rainwater KE5TC, P.O. Box 236, Keota OK 74941 USA.*

OCT 12–14

GREAT LAKES, IL The Great Lakes ARC will operate WV7T from the U.S. Naval Training Center, in celebration of the U.S. Navy's 221st Birthday. Operation will be 0000Z Oct. 12th–2359Z Oct. 14th. You can find them on the 80–10m band CW, SSB and RTTY. Please include the provided contact number on your QSL. For a certificate, send QSL and SASE/IRCs to *Great Lakes ARC, 2072-A Langley St., Great Lakes IL 60088 USA.*

OCT 19

DUNCANVILLE, TX Station KC5SJX will be operated by the South West Dallas County ARC, in conjunction with the Duncanville Harvestfest, 1300Z–2300Z. Operation will be in the Novice 10m phone and CW subband. For a QSL card, send QSL and SASE to *SWDCARC, P.O. Box 381023, Duncanville TX 75116 USA.*

OCT 19–20

EDWARDS AIR FORCE BASE, CA The MARS Base Support Team will operate N6SFV on amateur frequencies, 1400 UTC Oct. 19th–0200 UTC Oct. 20th, in conjunction with the Edwards AFB Open House and Air Show. Freq.: 7.265, 14.265, 21.365 ± QRM, and 6m and 2m SSB. QSL with SASE to *WA6NKL, P.O. Box 874, Acton CA 93510.*

BROWARD COUNTY, FL The Hollywood ARC will operate WB4TON from the Broward County Historical Commission Pioneer Days, in celebration of the 100th Anniversary of the Florida East Coast Railway in Broward County. The station will operate 1300Z–2100Z each day in the 40m, 20m, 15m General phone and 28.400 MHz in the Novice/Tech band. For a certificate, SASE to *HARC, 720 N. 71st Ave., Hollywood FL 33024 USA.*

OCT 31–NOV 1

BREVARD, NC The Transylvania County ARC will operate station KE4ZIS from Transylvania County NC on Halloween. Hours of operation will be 1900Z Oct. 31st–0100Z Nov. 1st. Freq.: 7.237, 14.295, 21.365, 28.335 SSB, and 146.52 FM simplex. For a certificate, send a business-size or 9"x 12" SASE to *T.C.A.R.C., P.O. Box 643, Brevard NC 28712 USA.* Weather permitting, operation will be from the Devil's Courthouse on the Blue Ridge Pkwy.

QRP

Continued from page 63

I did one version of the Two-Fer that everyone just hated. I really don't know why—the circuit worked as it should—but that project was a fizzle.

If you've been following this column for the last 10 years you may have noticed a dearth of receivers. I'm no RF engineer, so most of the receivers I've designed sucked! I'm working on it, so perhaps you'll see a simple superhet receiver one of these days.

Antenna tuners have been a problem. I can't find a solid source of inexpensive parts for a tuner. You can get one ready-made by MFJ cheaper than I could build one. It's one of those projects still on the back burner.

To me, it seemed kinda silly to build an amplifier in a column about low power communications. But there again, who knows? Perhaps I'll come up with an amplifier that's simple to build and set up.

Most, if not all, of the PC boards used in this column can still be obtained from FAR Circuits (18N 640 Field Court, Dundee IL 60118). Write to them and ask for a product listing. An SASE will speed up your request.

The coming new century

Low power ham radio is enjoying steady interest. It's easy to just plunk down your plastic and walk home with a complete radio system. In one small box, you get built-in antenna tuners, DSP, and a zillion other goodies. In some cases, if the operator needs to have a microphone connector installed, he or she must find someone else to install it.

QRP means low power ham radio. It does not mean using decades-old circuits. In fact, you'll find plenty of microprocessors in our QRP gear. The QRP+ from Index Labs is a good example of what you'll come up against in the QRP field today.

During the next 10 years, we'll keep you informed as the latest and greatest equipment comes along. Right now, I'm busy trying to teach myself 68HC11 assembly programming. Who knows? In a year or so, you may see a home-brewed micro-based QRP rig presented in this column. In the meantime, let's just have fun!

What's All This QRP Stuff?

Home-brew a QRP rig.

Ken Gledhill AA7PE
19503 Via de Arboles
Queen Creek AZ 85242

It was shortly after midnight when I finally soldered the last connection to my home-brew multiband QRP rig. The project had consumed many of my evenings and weekends for most of the past year. The receiving portion of the project had been working for several weeks: now was the moment of truth—time to try the transmitter.

The oscilloscope showed that my voice was running 30 volts peak-to-peak across the 50-ohm dummy load. That figured to be just a bit over 2 watts of peak envelope power (PEP) on 10 meters. It was late, so I suspected that the higher bands would be shut down, and a few minutes of scanning up and down 10 meters confirmed my suspicion. So I telephoned and woke N7RSR, a nearby ham friend. I knew he'd understand—he's as crazy as I am about such things. We agreed to meet on 28.500 MHz. After a couple of short calls I received a sleepy response: "Your frequency is pretty close for an analog rig."

The next day was Saturday. There were a number of stations up and down the band, including one from the Fiji Islands. There was a big pileup of stateside stations trying to get through. I figured that it was a long shot with only 5 watts on SSB, but I called anyway. I missed him. He came back to a big station from California. I waited and tried again just as they signed off with each other. This time I heard "Go ahead AA7PE." I couldn't believe it! With only 5 watts, my SSB signals had reached Fiji with a respectable 5 by 5.

"With only 5 watts, my SSB signals had reached Fiji with a respectable 5 by 5."

Usually CW transmitters with output power of 5 watts or less are classified as QRP rigs. However, SSB voice transmissions may be up to 10 watts PEP and still be considered QRP. There are really no absolutes with these definitions, but these values seem to be widely accepted among QRP enthusiasts. These power levels are a maximum for QRP, and it's not uncommon to find QRP transmitters that operate at considerably lower power.

So why is 10 watts considered QRP for SSB rigs when the QRP limit for CW is only 5 watts? Consider first a CW transmitter. Assume that the key is up for approximately half of the time and down for the other half. Under these circumstances, a 5 watt CW transmitter will have an average output power of 2-1/2 watts. The average output of an SSB transmitter depends on your speech patterns, but the average output power of a 10 watt SSB transmitter is usually fairly close to the same 2-1/2 watt value.

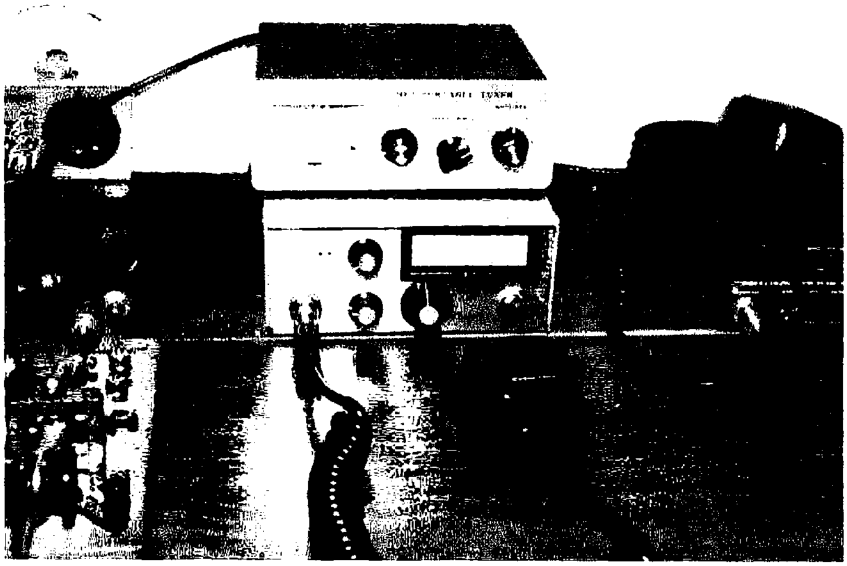

Photo A. The author's QRP station. In the center of the photo is a home-brew 5 watt SSB transceiver that operates on the 17 meter band.

Signals vs. noise

Although the power radiated from a 5 watt CW transmitter is comparable to that coming from a 10 watt SSB rig, the ability of the receiving operator to interpret the signal at the receiver is not the same. The difference in intelligibility is due to a couple of factors. The first is the signal-to-noise ratio (SNR), which is a measure of the degree to which a signal stands out above the background noise. If a signal is received with a high SNR, there is very little interfering background noise and the message is readily understood. Conversely, signals received with a low SNR are buried in noise and difficult to interpret.

There are a number of factors that affect the SNR of a received signal. One is the bandwidth of the receiver. Some

receivers use the same bandwidth for both SSB and CW signals so there will be little difference between the received signal-to-noise ratio of a CW signal and that of an equally strong SSB signal. However, if the receiver has a narrow filter, a considerable improvement in the CW signals results. For example, a 2100 hertz SSB filter allows five times as much noise power to pass through it as does a 400 hertz CW filter. With the lower noise power admitted into the receiver, the ratio of the signal power to the noise power is improved. Looking at the situation another way, a receiver using a narrow CW filter can distinguish a 5 watt code signal with the same degree of clarity as a 25 watt signal passing through a wider SSB filter. This feature underscores one of the key reasons that CW is the mode of preference when operating QRP.

CW has a second intelligibility advantage over SSB transmissions, even when received with a similar SNR. For a voice message to be properly understood, it must stand out above the background noise enough for the listener to distinguish the spoken syllables and link them into meaningful words. To distinguish among similar-sounding spoken letters such as P, B, E and D, a phonetic alphabet has been developed.

In contrast to spoken messages, CW doesn't require the listener to distinguish among subtle differences. The signal is either on or it's off; it's much easier for the human ear to copy the message in a noisy environment.

S-meters

Most receivers are designed so that each S-unit represents a fourfold difference in the received signal power. That means that the received power from a signal registering S8 on a particular receiver's S-meter is approximately four times that of one received with an S7 reading. Therefore, if the signal from a 100 watt transmitter registers S9 on a particular receiver's S-meter, by reducing the output power to 10 watts the S-meter reading would only drop to a little over S7.

One evening I was involved in a pleasant SSB contact on 17 meters with a ham located a few hundred miles away. When I mentioned I was only running 5 watts he was surprised by how well my signal was doing (S7) and asked me to check his signal for a test. His 100 watts tipped my meter up to S9 during audio peaks. When he reduced his transmitter power to 50 watts I could see no change in his S-meter reading. He then reduced power twice more, finally ending up at 10 watts. His signal was still a solid S7 on my meter.

ionospheric skip seems to occur more frequently. Noise and absorption are noticeably less on this band than on the lower frequency bands.

20 meters is a very popular band. It often works well for QRP, as it did for me when I connected with the Fiji station.

"Put your money and your time up in the air."

When operating QRP you'll meet all kinds. Shortly after making the Fiji contact I hooked up on 10 meters with a ham about 500 miles away. He said I was pushing his S-meter to a little over S9—but after I explained that my rig was only running at 2 watts, he revised my signal report to an S4. I often get better signal reports if I don't mention my power.

When the ionosphere is cooperating, QRP rigs work just fine. But when the sunspot numbers are low it is not uncommon to tune the entire 10 meter band without hearing a single station. In this condition not even a kilowatt will work.

Your antenna is critical

The better the antenna, the better your signal, since a good antenna improves both the received and transmitted signals. Put your money and time up in the air.

Operation on the lower frequencies is usually most effective when vertically polarized antennas are used. Higher frequency signals do better when horizontally polarized. A beam antenna can add as much as two S-units to your signal strength.

Which band is best?

If you're looking for reliable short-range QRP contacts, then 80 meters is a good choice. Clubs should find this band ideal for local on-the-air round-table discussions. Atmospheric noise can be a significant challenge on this band. The daytime range for an 80 meter QRP SSB rig is usually up to 25 miles. At night contacts can be made over longer distances, with contacts up to 120 miles not uncommon.

Long distance QRP contacts are more likely on 40 meters—especially in the evenings. This is my favorite CW band.

Voice is not allowed on 30 meters, so this is an excellent band for CW. Long-range propagation on 30 meters is similar to that on 40 meters except that

However, the popularity of this band often creates pileup conditions that favor the high-power rigs. Successful QRP on this band hinges on your skill and patience.

The higher HF bands of 17, 15, 12 and 10 meters are great for QRP. I've had many successful long-distance QRP contacts on these bands.

Clean signals win

Although there are subbands reserved for QRP operation, most reduced-power contacts are made with stations that are not operating QRP rigs. Indeed, many hams don't really enjoy trying to pull a weak signal out of the noise. However, you can increase your success by making sure your signal is clean, with no clicks or chirps. Listen to a recording of your signal so you can hear what your "fist" sounds like. On SSB, while audio compression provides a bit more average output power, I have found that my QRP signals seem to be more intelligible to the receiving operator when they are unprocessed.

The excitement of hearing your callsign breaking through the background noise as it returns from some distant point on the globe is hard to explain to the uninitiated. By learning to be an effective QRP operator you can beat the odds more often, enhancing your enjoyment in ham radio's most satisfying challenge.

Number 82 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
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70 Route 202 North
Peterborough NH 03458

Stress!

It's a concept with which we've all become too familiar, as we attempt to cope with it in our daily lives. Did you ever stop to consider, though, that your electronic equipment is also subject to stress? Just as you can stand only so much before you finally break down, your radio gear will also quit if the stress gets too high. In fact, many equipment failures are due to stress. This month, let's take a look at the types of electronic stress and how it affects various components.

Electronic parts and assemblies are adversely affected by three primary kinds of stress: mechanical, electrical and thermal.

Mechanical stress

Most mechanical stress occurs when sudden force is applied to the unit. In other words, if you drop it. Or, perhaps, a mobile radio could get broken after your car goes over a particularly violent bump. Maybe you carry your HT in your back pocket, and you forget and sit on it.

Dropping rigs usually results in serious damage. The parts most affected are the PC boards and anything made of glass, such as LCD panels. The point of impact will be hit especially hard, but other spots can get wrecked, too. In particular, the corners of PC boards frequently crack or break off. With simple, single-sided or double-sided boards, you can often fix them with wire jumpers. With multilayer boards, you're most likely out of luck. Fortunately, very little ham gear uses multilayer boards, but expect that to change as radios get smaller and smaller. The modern, 1.5-pound camcorder makes extensive use of boards up to six layers deep (!!), and future HTs undoubtedly will, too.

Board cracks often occur in the area of larger, heavier components, such as transformers, big electrolytic caps and power transistors, because their greater mass exerts more force on the board when the unit hits the ground. Sometimes the cracks will be quite obvious, while other times you may need a magnifying glass to see them. Now and then, the component will break the foil but not the board itself, making it even harder to find the trouble. Such breaks tend to look like cold solder joints, and almost always occur on large connections. I've never seen them happen on little transistors, but I've run into plenty of them on power transistors and transformers. When in doubt, resolder.

Double-sided and multilayer boards use what are called "plated through" holes. Essentially, the walls of the holes have copper linings. This technique makes for solid, trustworthy connections between layers, but it has a few drawbacks. The best-known one is that plated through holes make it very difficult to remove parts. Because solder sticks to the plating, you can count on the holes' being filled with solder, and you have to get them really hot in order to melt it all at one time. If you're not successful at that, you'll damage the board, either by lifting and tearing the plating on one side (usually the component side, which is farthest from the iron), or by pulling the plating right out of the hole! I've seen that happen more than once. Although it can be disastrous with multilayer boards, double-sided boards usually survive this problem; you just have to be extra careful to solder the component lead on both sides of the board.

> **"When in doubt, resolder."**

The result of sitting on an HT is pretty much the same: The board and display get cracked, often so badly you can't fix the radio. This time, though, the larger components aren't the issue, as the force has not been transmitted to the board through them. Cracks may be distributed fairly randomly over the PC board, which is a big part of the reason the radio may be ruined. At least with cracks resulting from drops, there's usually a pattern.

Vibration-induced damage is somewhat different. Although the board can, indeed, be cracked, it often isn't. More likely, the solder joints themselves are affected, and you can easily resolder them (if you can find them!).

Mechanical stress affects more than PC boards, though. Switches, controls and jacks are particularly subject to it. Pots get scratchy and intermittent from being constantly turned back and forth, and switches may start making unreliable connections for the same reason. Sometimes contact cleaner helps, sometimes it doesn't.

Electrical stress

Within the category of electrical stress, there are two kinds: over-voltage and over-power. Over-voltage stress induces failure in all kinds of parts by punching microscopic holes in them! Electrons being the energetic little critters they are, they'll try and force their way through any kind of barrier. Raise the voltage, or electromotive force (EMF), of those electrons enough and they can go right through the substrates and molecule-thin barriers designed to keep them where they belong. The result is a short circuit inside a part.

Prime candidates for over-voltage stress failure are electrolytic capacitors, transistors, FETs, CMOS parts, and integrated circuits in general. But what causes the over-voltage condition in the first place?

Voltage regulator failures can cause the supply to put too much voltage into the wrong part of the radio. This happens more often than you might think, particularly when a secondary 5-volt regulator shorts out, sending the main 12-volt supply to a bunch of TTL gates or a microprocessor. *Poof* go the parts. If you change them without checking that regulator, the new parts suffer the same fate almost as fast as you apply power.

Depending on where you live, static electricity can be a serious problem. Northern winters can get extremely dry, and static can build up without your even realizing it. You touch your radio, and you feel ... nothing. The radio, though, receives a huge jolt and stops working. Of course, if the static charge is big enough, you'll feel it, but it sometimes takes much less voltage discharge than you can feel to do significant damage to electronic equipment. That's why it really pays to touch something grounded before handling your gear in winter.

Thunderstorms can have the same effect. I've seen computers fail to boot up the day after a storm, even though no obvious lightning damage occurred. Sometimes the machines will start working again, without intervention. Apparently, a static charge has built up somewhere, and it eventually discharges. Of course, sometimes there is actual damage, too.

Over-power stress is just what it sounds like: Too much power is passed through a component, heating it up and blowing it. In a sense, it's a kind of thermal stress, the difference being that the heating is internal, rather than from an external heat source.

The usual cause of over-power stress is a shorted component pulling too much current through another one. I call this "over-power" rather than "over-current" because current doesn't tell the whole story; it's the amount of current at a particular voltage that does the damage. So, over-power stress is best thought of in watts, not amps. That's why resistors, for example, are rated in watts. A 1/2-watt resistor could easily stand 5 volts at 50 mA (.05 amps), but 10 volts at the same current would put it at its absolute limit, and you could expect it to fail in a short period of time.

Another cause of overcurrent failure is bad design. We like to think our equipment is well-designed and will last a long time if nothing unusual occurs. Typically, that's true, but not always. Sometimes what looks right on paper just doesn't cut it in the real world. It's not unusual for a specific model to have a recurrent

problem, due to the design's not being thoroughly tested. I remember one VCR model, back in my service tech days, that blew the same transistor over and over again. Every time one would come in, we'd just go right to the same part and replace it. It worked every time, because it was always the same problem! When manufacturers figure out they've got a problem, they usually try to correct it through an engineering change order, or ECO, that changes parts or procedures. That's what service bulletins are for, and many pieces of gear have them. Some have whole books of them!

of RF power, you're going to have to dissipate anywhere from 20 to 70 watts or so of heat, too.

Heat-producing parts, such as power transistors and RF final amplifier modules, are heatsinked to a big piece of metal, which is often the chassis of the radio itself. If the rig is properly designed, most of the heat will flow into the metal and away from the semiconductor producing it. As long as the whole set stays under a certain temperature, everything's fine, as no part gets hot enough to sustain damage. But if the fan fails, or you mount the set in direct sunlight, watch out for trouble. Some designs

"It worked every time, because it was always the same problem!"

Thermal stress

Thermal stress is overheating from some external source. The source can be anything from a hot component a millimeter away, to the sun in a hot car. Any way you slice it, heat is the enemy of electronics—period. Of course, some parts have to get hot in normal operation. Unlike in the tube days, though, the heat is pretty much never a desirable or necessary condition. Still, nothing's one hundred percent efficient, and some heat will always be generated. If you try and make 50 watts

aren't so well done, and the radios tend to overheat anyway. Tiny HTs get ridiculously hot when you transmit for long periods at 5 watts output or more. If the thing is too hot to hold, just imagine what's going on inside! The heat may not cause immediate destruction of the rig, but its lifetime is sure to be seriously reduced.

Now that we've covered the basic stress guidelines, we'll take a look at individual components and examine the kinds of stress to which they're susceptible ... next time. Until then, 73 de KB1UM.

HOMING IN

Number 84 on your Feedback card

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92837

Dirty Tricks = Valuable Training

When April WA6OPS and I discovered two miles of power line maintenance road running through the hills behind new houses in east Yorba Linda, we knew our search was over. We were checking out the area because it was our turn to be hiders for the monthly Fullerton Radio Club (FRC) hidden transmitter hunt, along with Tom and David Curlee WB6UZZ and KE6IPY. We call these events "T-hunts" here in southern California; in some other places they are called "foxhunts."

The site we chose was ten miles due east of the hilltop where the hunters would gather to start. Over the years, FRC T-hunters have gotten so good at radio direction finding (RDF) that it could be a short hunt, unless we added a few twists.

First we put up a 4-element yagi, coax, transmitter box and battery on the roadside fence. It would have been a functioning hidden T, except there was no fuse in the 12-volt power cord. Next to this decoy was a sheet for the hunters to sign in and record their odometer readings.

The real signal on 146.565 MHz at 8 PM on hunt night came from a quarter-watt handie-talkie in a surplus military ammunition can that we concealed in the brush about 60 feet away from the fake T. In accordance with the hunt rules, any passenger car could be driven to the site by going a few miles east of it into a new housing development, then back west on the wilderness road. We parked our car on a street three quarters of a mile west of the site, expecting to see hunters trying to get there by that route.

Time is not a factor on the FRC hunt. The team with lowest mileage traveled wins. Nevertheless, all of the seven hunting teams were close after a few minutes. Three followed the signal to our observation post and tried going out a dirt road there, only to encounter a locked gate a half mile west of the T. Others parked at another locked gate south of the site and hiked several hundred feet north up a steep hill. Only one team (WB6DCC, WB6DCB, KD6HWD, and KD6MCM) drove to it via the power line road, which gave them high mileage at that point.

Every team stopped upon spotting the decoy, signed in on the sheet, and called us on the frequency posted there. We told them that if they believed that they had found transmitter #1, they should next try to find a second transmitter we had hidden on a different frequency. The FRC hunt normally has only one transmitter to find, but all teams had signed in within an hour and forty-five minutes, so it wasn't hard to convince them to do some more T-hunting.

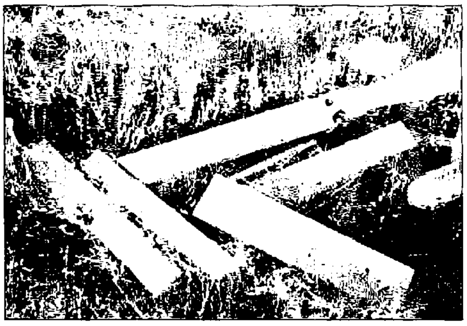


Photo A. The "Stud T" looked just like all the other two-by-fours in the pile. In fact, it had been in precisely that same spot a week earlier when I picked it up.

The Stud T

Transmitter #2 was only 1.6 miles away atop a hill, but it was no ordinary hidden T. In a pile of scrap lengths of two-by-four lumber, one piece was different (**Photo A**). A microtransmitter, batteries and dipole wires were actually inside the two-by-four. The wood shop magic was courtesy of WB6UZZ. He sliced it like a bagel and hollowed out the insides. Then I fastened the electronics in place with hot glue (**Photo B**).

Instead of a tone generator, this T had a very sensitive mike. From our parking spot, we could easily hear the hunters approach it. We were not secretly "bugging" them, because they realized what was happening within 50 feet of the T when their receivers started squealing with audio feedback. They were able to zero in by turning down their receiver audio as they approached and then banging on the two-by-fours until they found the right one. Five teams grabbed it more or less simultaneously and called us on the frequency on a little label next to the tiny mike holes in the board.

At that point, we announced that no team had as yet tracked down the *real* transmitter that they had started out to find. In a stampede, almost all the teams headed off to try again. Apparently, they all drove back to the points from which they had started walking the first time. The WB6DCC team, having discovered the eastern route earlier, added much less mileage than the others. As a result, they ended up as winners. Most teams pounced on the real T #1 and checked in within 15 minutes, so there was still plenty of time left for food, talk, and a close examination of the "Stud T" at a nearby restaurant.

Most T-hunters like intrigue and cunning, so they were good sports about the deception. Don Lewis KF6GQ wrote on E-mail the day after, "We knew that you had pulled something tricky, but when I tried to sniff it out with the rubber duck, all I got was a stronger signal on the other side of the fence. When we came back (the third time for us), I took the 3-element beam and DFed it down myself, instead of watching the others and checking in at the decoy as I'd done the first time. Never, never, never trust what you see others do! It was a very, very good hunt because it was both fun and frustrating."

Tom and I certainly were not the first to camouflage a hidden T or even to encase it in wood. The Internet RDF mailing list has had transmitter-in-a-log stories from Seattle, Washington, and Melbourne, Australia, in the past year. There is no limit to clever disguises, so experienced hunters have learned to always carry along good on-foot RDF gear.

Decoys are unusual also, but they are not new to our hunts. Ken Diekman WA6JQN was probably the first to use them here fifteen years ago. They serve a valuable purpose because they remind hunters to pay attention to their equipment. T-hunting is an RDF exercise, not an eye test. If hams are going to convince the FCC that we are good enough at it to provide evidence for jammer prosecution, we had better always find the real transmitting turkey and never falsely accuse an innocent ham with a big beam next door.

Helping hams in the heartland

The fun and camaraderie of hidden transmitter hunting pays off doubly when the RDF skills it develops are used for public service. Examples of this can be found in Omaha, Nebraska. According to television engineer John Gebuhr WBØCMC, the Ak-Sar-Ben Amateur Radio Club has encouraged T-hunting for many years.

"On our monthly foxhunts, we just go out and have a good time," John says. "Usually they are held on the Sunday afternoon following the monthly club meeting, but we have also had them in the evening hours. Sometimes we have a picnic afterwards. The fox uses the radio club's call and results are published in the club paper, but they are kind of a loose informal event.

"Most hiders use the club's fox transmitter," WBØCMC continues. "It's in a weatherproof container, battery powered, and will run for six hours at one or 10 watts. It comes on for one minute and then shuts up for three. We start the hunts from the University of Nebraska parking lot. The fox has been in dumpsters, up in trees—you name it. We've done

a few mileage hunts, but usually the first team to locate it wins and gets to hide the fox the next month.

"I drive a T-top and use a 3-element beam on a wood pole that sticks up into the air. We had one guy some years ago who had a Doppler and was pretty good with it, but most of the guys now are using handie-talkies and beams. In fact, some of them just use handie-talkies and body shielding. The boundary is pretty broad, including most of Douglas County and over to Pottawattamie County in Iowa. Sometimes the hider will put the fox along the Missouri riverbank, and the big trick becomes trying to figure out which side of the river the thing is on."

Nebraska's ARRL Section Manager Bill McCollum KEØXQ is another regular hunter. He and WBØCMC have used their T-hunting skills several times over the years to track repeater jammers and bootleggers. "Some of the bootleggers that we've tracked down eventually turned into good hams," Bill says.

"We keep on top of it," John adds. "When turkeys pop up, we find them, they know they have been identified and we just don't have the problem again. For example, about a year and a half ago in the dead of winter, somebody would come on at 2 AM every morning and get on the autopatch, dial up numbers and never give a callsign. Bill and I nailed him and the problem went away."

Of course, not all interference is deliberate. Sometimes it's the result of a technical problem. According to John, "One day we started hearing military voices over one of our repeaters. I quickly determined that the signal on our input was coming from Offutt Air Force Base and called Communications out there. I told them, 'Your generals are being heard all over Omaha.' In an hour the interference was gone."

The Amateur Auxiliary to the FCC has been a success story in eastern Nebraska. John says, "Before the FCC's monitoring station at Grand Island closed, I would sometimes get a call from Rebecca out there asking the hams to check something out. We found all kinds of technical problems, spurious transmitters and such. Usually when we find somebody with a bad transmitter, it's fixed within a week. There was only one such incident that we really had problems resolving, and that was a major industrial company and its RF heating equipment at 13 MHz. The transmitter had a free-running oscillator with no frequency control except one tuned circuit.

"The little antenna they were using to couple 10 kilowatts into the work happened to be 19 inches long. So guess where the worst harmonics were! They were getting into every repeater in the Omaha area and even into Fremont, 32 miles away. They were getting into our 222 and 440 MHz frequencies, too, but not as bad. Because they had a harmonic in the aircraft band, we were able to get pressure from the government to get it fixed."

"'Your generals are being heard all over Omaha.'"

RDF services by Omaha hams are not limited to Amateur Radio bands. They have helped other local agencies as well. "Seven or so years ago, I got a call from Douglas County Civil Defense (CD), which uses a frequency near 155 MHz," says WBØCMC. "That agency is responsible for setting off sirens for tornado warnings and such. Somebody had been giving false calls on the CD frequency. It had gone on for two nights and they figured there was a good chance he'd be out that night, too.

"We got five teams out. Sure enough, he came on and we tracked him to the Douglas County Annex building. It turned out to be a security guard who had picked up a CD handie-talkie from the charger. I called the CD chief and they sent the Sheriff out there. It didn't happen again."

Always gets his man

"John is really good at RDF," says KEØXQ. "There hasn't been anything yet that he hasn't been able to find." The most recent and most serious mission came on April 3, 1996. As Bill and John were talking on the phone, Bill noticed that Omaha Police Department radio calls were coming through the 146.94 repeater. "At first we thought somebody had a stuck 2 meter radio with the mike on top of a scanner," Bill says. "Later we found out that police cruiser radios were picking up hams talking on their channel at the same time."

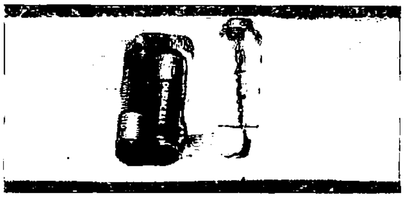


Photo B. WB6UZZ used a router to make room for the hidden T parts. The two-meter transmitter is manufactured by Agrelo Engineering, 1145 Catalyn Street, Schenectady NY 12303 (518) 381-1057.

The two T-hunters drove around Omaha for about a half hour without hearing the police on the 2 meter repeater input. Then, on a hilltop west of Boys Town, John began to pick up a faint signal. He decided to go to Elkhorn, about six miles northwest of the city, where there is an Air Force antenna farm. It wasn't there, but the signal was about 20 dB stronger and still to the northwest. "I think it's in Fremont," John told Bill.

By this time Bill was in Bellevue, on the other side of Omaha. John continued westward. "Trying to drive and hold a three-element beam in a 60 mile-an-hour headwind doesn't lend itself well to precision RDF, but I could tell that the bearing continued to point right toward Fremont," he says. "I was in kind of strange territory, so I decided to get a local ham to go with me. I called Mac McCabe WBØIBV in Fremont. He said he would love to help. I also called the Dodge County Sheriff's office to see if they had a deputy to go along for safety's sake. These days, one never knows what he may run into when knocking on doors.

"The deputy got there before Mac and pulled up alongside my car. He looked at the car, looked at the beam sticking out of the roof and then started to chuckle. I explained who I was and what was going on. Mac showed up and off we went."

A few minutes later, they pulled into a parking lot where the signals were super-strong. They asked the workers there if anyone had left a 2 meter radio on. One went over to his car, got in, and the interference stopped abruptly.

To link ham and police frequencies together, the perpetrator had to set up his dual-band radio in the repeat mode with the right frequencies, offsets and subaudible tones on both UHF and VHF. "It became obvious that this was deliberate," says WBØCMC. "Most people who do something like this inadvertently are apologetic when confronted. Not so here. This fellow was very tight-lipped, wouldn't look anybody in the eye, and gave the impression that he hadn't thought he'd get caught. We identified him, turned our information over to the authorities and haven't had a recurrence.

"We made some real good friends with the Omaha 911 people as a result of this. The following Saturday, several of us met with the 911 Chief of Communications and the Assistant Douglas County Civil Defense Director. We got lots of thanks and an opportunity to give them a briefing on the Amateur Auxiliary program."

Let's go browsing

The new "Homing In" site on the World Wide Web is a good way to learn how to get your club started in hidden transmitter hunting. Besides answers to the most frequently asked questions about RDF, you will find Web links and E-mail contacts to hunt groups in cities and towns all across the country. Point your browser to http://members.aol.com/homingin/ to check it out and then let me know about T-hunts in your town. You can send E-mail to Homingin@aol.com or snail-mail to the address at the beginning of this column. 73

Never say die

Continued from page 61

most of these things, and that the results can be all kinds of lingering illnesses.

On the bright side, the book explains how simple it is to find out what you are allergic to so you can avoid that allergen. It's merely a matter of counting your pulse rate after eating or exposure to different substances. With foods, you can isolate which are treated as hostile by your body just by checking your pulse several times after eating. Well, get the book.

Yes, I'm selling my list of recommended books for $5. If I were selling the books, it would be a free catalog. But the list is the result of a lifetime of reading and the revenue from it goes for photocopying, folding, assembling, addressing and mailing it, plus money to buy more books. So far this month I've bought 17 more books, most of them on the recommendation of readers as books *I* really ought to read.

Getting back to allergies, a recent TV documentary introduced me to Dr. Doris Rapp, who explained that many of the behavior problems kids have stem from allergies. Like hyperactivity, attention deficit disorder, dyslexia, poor grades, fatigue, personality changes, poor concentration, depression, and so on. I probably should put her book, *The Impossible Child*, 161p, $11, ISBN 0-9616318-1-3, on my list, particularly for parents—though people of all ages can have these same reactions to allergens.

My hay fever hit not long after childhood immunization shots. I had the usual scratch tests, where I was found allergic to dogs and cats, a few foods such as cheese, trees, grasses, and most pollens. Dr. Coca's book explains that the scratch test misses many allergens and that the pulse test is much more reliable. It's also one heck of a lot easier and cheaper. Which probably explains why few doctors are aware of the test, even though it's been around for over 40 years.

Apropos that, I've already mentioned the inexpensive cure for epilepsy which one determined doctor has kept going at Johns Hopkins Hospital, but which otherwise would have been lost. I keep finding out about more and more buried medical treasures like these. But then the medical industry is in the hands of a few pharmaceutical companies, the music industry is totally under control of seven international music companies, and so it goes, with us paying the tab while we sit here watching ball games and drinking beer.

"An AMA report showed that doctors live an average of 58 years, while the rest of us manage to live an average of 75 years."

Those Pesky UFOs

I see where the Pentagon has managed to produce a five-pound book whitewashing the "Roswell incident" of almost 50 years ago. News flash: It *still* was a weather balloon. Sure. But if you've read anything about it or seen any of the several exposé TV shows on the subject you'll know the Pentagon is again handing out baloney.

Oh, I agree there are a lot of crackpots involved with UFOs. But then, there are a lot of crackpots involved with anything arguable. In general, crackpots are people who have not bothered to do their homework, but have not let that interfere with them having strongly held opinions. Or, on a more practical level, a crackpot is someone who strongly disagrees with you on some subject, whether you have any real basis for your beliefs or not.

Is Strieber, who wrote *Communion*, and more recently, *Breakthrough*, a crackpot? His story of his many contacts with the alien visitors is fascinating and makes sense. Are the millions of people who have reported seeing UFOs all crackpots? How about the thousands of contactees with stories similar to Strieber's?

A reader says he's been able to photograph UFOs reliably by using a building or something to block out the sun so he could take pictures of the sun's corona. He says the UFOs are coming and going from the direction of the sun and thus aren't easily seen. He described 15 different types of UFOs he spotted in just a two-day vigil.

So if there are aliens visiting us, why aren't they open about saying hello? I suspect it's because they are on scientific expeditions, not military, and they've been doing this for a long time—possibly for thousands of years. I don't think you'll disagree with me that we have not progressed socially to the point that it's safe to mess with us. The hints of their technology tell us that our visitors are far ahead of us, so what possible benefit would it be for them to do more than unobtrusively observe us? If we could go back and visit Earth the way it was a million years ago, would we land and say, "Take me to your leader?"

Well, you're interested in communication. Our visitors aren't using radio, which makes sense to me, so how are they communicating?

I Haven't Got Time

A friend called. When he mentioned having been sick, I naturally suggested he get some books on health and take some responsibility for his body. He said he didn't have any time to read. I don't either, but knowing how important it is to my goals in life (like living as long as I can so I can accomplish my other goals), I *make* the time.

Books, such as those that are on my $5 "books you're crazy if you don't read" list, can help extend your life on to 100 or so. For me that's another 25 years to learn and teach.

Like most other people, I was inculcated by our school system to believed that school and college were the main ways to learn. Experience has taught me the long, hard, expensive way, that you can learn more with a good book in a few hours than you can in college in a few weeks. You don't have to go to a class to learn about radio and electronics, all you need to do is read some books and you'll soon know more than most of the teachers. We're so brainwashed that few people ever even think to question the value of college. My folks never did. Heck, my father came along at WW1 time and missed college. He went to New York Military Academy and from there into the Army as an officer. That got him into aviation with the Army Air Corps. But he always felt the lack of a college degree, even when he was busy starting new airlines. He started three of 'em, including the first trans-Atlantic airline.

"Reading books, such as those that are on my 'books you're crazy if you don't read' list, can help extend your life on to 100 or so."

In just a few weeks of reading you can become an expert on almost any aspect of electronics. But, like exercise to build strength, you do have to tackle the job conscientiously.

I keep bringing up health because you're not going to be able to do much if you're heading for a heart attack or cancer, like over half of your friends. That road is for the ignorant. Ditto all of the chronic illnesses, including diabetes, arthritis, and so on.

You can give me a hand with this. Every time you buy an electronics or radio book, please read it carefully and then send me a book report for possible publication in *73*. If it's a bad book, the review will help spur the publishers to do better. If it's a good review, I want to know so I can read the book, and so do the other *73* readers. It'll also help sell a bunch of books, and that too will encourage the publishers to do better and stop publishing junk and textbook-type boring stuff.

Amateur radio can once again be worth its salt if I can get you to take advantage of the many opportunities for pioneering. But to do that you have to start by learning all you can. Will it be a ham who develops and pioneers digital communications? We did that with FM, NFM, slow-scan, and sideband. But so far we're sadly behind when it comes to digital voice systems using data compacting algorithms.

I'm reading every club newsletter I get, looking for any signs of hams doing anything more than having fun with a hobby. I see no signs. That's why I get so nervous and critical when I read about the ARRL getting pushy with the FCC over one thing after the other. It just doesn't pay to give the boss a hotfoot.

Number 87 on your Feedback card

PROPAGATION

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Special Forecast

Cycle 21 bottomed out in December 1986, and it now looks like Cycle 22 will bottom out around December 1996 ... just 10 years later. Yes, I had predicted an earlier (May) sunspot minimum, but Old Sol is hanging in there with depressingly low flux values (around 70) which refuse to climb out of the basement. The pundits are now saying that the reported spot of the new cycle was just a fluke ... a Chimera ... an apparition. Frankly, I don't think so. It was real enough and was, in fact, the harbinger of Cycle 23, I believe.

As propagation goes, October could be an *awful* month; either wonderfully awful or awfully wonderful. I predict that the days surrounding the 10th and the 23rd will show some remarkable and extensive geophysical disturbances: possible hurricanes, volcanic eruptions, and earthquakes.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

OCTOBER 1996

SUN	MON	TUE	WED	THU	FRI	SAT
		1 G	2 G	3 G-F	4 F	5 F
6 F-P	7 F-P	8 P	9 P	10 VP	11 P	12 P-F
13 F-P	14 P	15 P	16 P-F	17 F	18 F-G	19 G-F
20 F	21 F-P	22 P-VP	23 VP-P	24 P	25 P-F	26 F
27 F	28 F-P	29 F-P	30 P	31 P		

Heaven knows, there might even be an active ionosphere! It sure is about time! Whatever happens, it won't be docile and calm. Maybe there will be a stock market crash ... it's the right month.

When solar flux is very low, as it has been for months, an ionosphere storm could be a boon and kick the flux up where we'd like to see it ... at least for a few days. When flux is high, as at the peak of a cycle, an ionosphere storm often results in too high a flux value and poor conditions. Therefore, I'll suggest that the days marked P or VP on the chart could, in fact, be very *good* days for propagation, so keep those receivers tuned to the higher HF bands and hope. Also, keep your emergency gear ready for anything!

10-12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15-17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the U.S.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30-40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and night-time short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

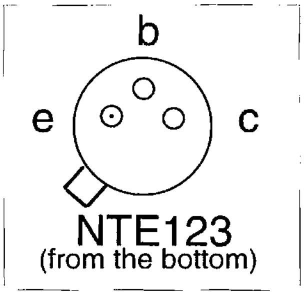
160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. W1XU. 73

UPDATES

You say you're having trouble with that preamp...

Before you spend another weekend trying to find out what went wrong with that preamp circuit that you constructed according to Roland Burgan KB8XI's article (August *73*), take a look at the pinout diagram that was inadvertently omitted from the schematic:



BEAR-ly There

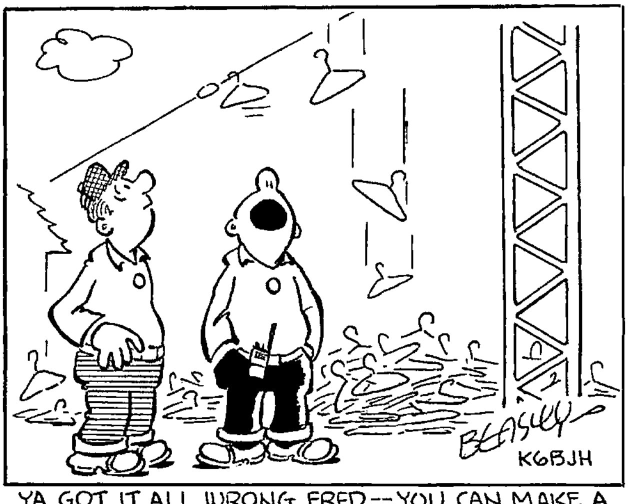
The June table of contents erroneously credited Pete Kemp KZ1Z's article "The BEARS Hunt the Fox" to Mike Bryce WB8VGE.

The Book List by Wayne Green. This is a list of 83 books that I say you are absolutely crazy if you don't read. And none of this "I don't have time to read" crapola. These books are the best books I've found in a whole bunch of fields. Many were recommended by readers as being top notch. It's time to become educated on health matters, our school system, our corrupt government, history, science, communicating with plants and animals, child development, the occult, and so on. Order **BL** $5 from Radio Bookshop.

It could happen to anybody...

In KB4ZCG's August article, "Simple Crystal Activity Tester," the R5 Øk ohm potentiometer in the parts list should read, **"R5 10k ohm potentiometer**."

NASA Mooned America by René. The proposition that the Apollo flights were all faked and NASA never got anyone to the moon is patently ridiculous. I'm still waiting to hear from anyone who has read this book and still believes the moon landings weren't the biggest hoax in history. René has done his homework thoroughly and cites 30 darned good reasons why he thinks we've all been lied to. 176p, 8½ x 11. Order **NA** $25 from Radio Bookshop.

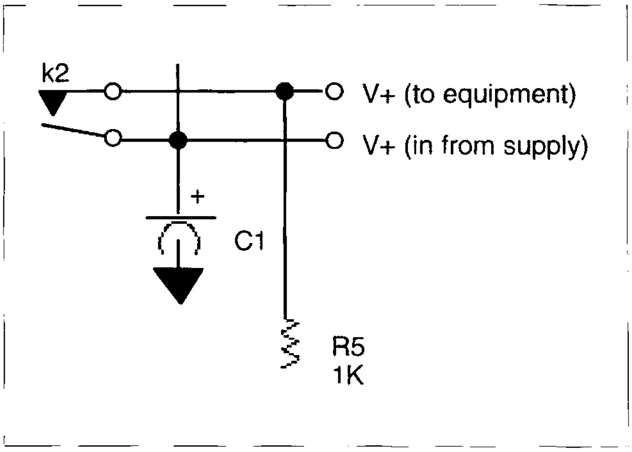


YA GOT IT ALL WRONG, FRED--YOU CAN MAKE A 2 METER GROUND PLANE OUT OF WIRE COAT HANGERS, BUT NOT A 20 METER BEAM!

"R2... see if you can lock down that stabilizer."

In Frank Brumbaugh's "Automatic Voltage Controller" August *73*, look at the first line of the third column of page 46. The R5 that's there should be an R2.

The schematic on page 46 was missing the visual for C1. Here it is:



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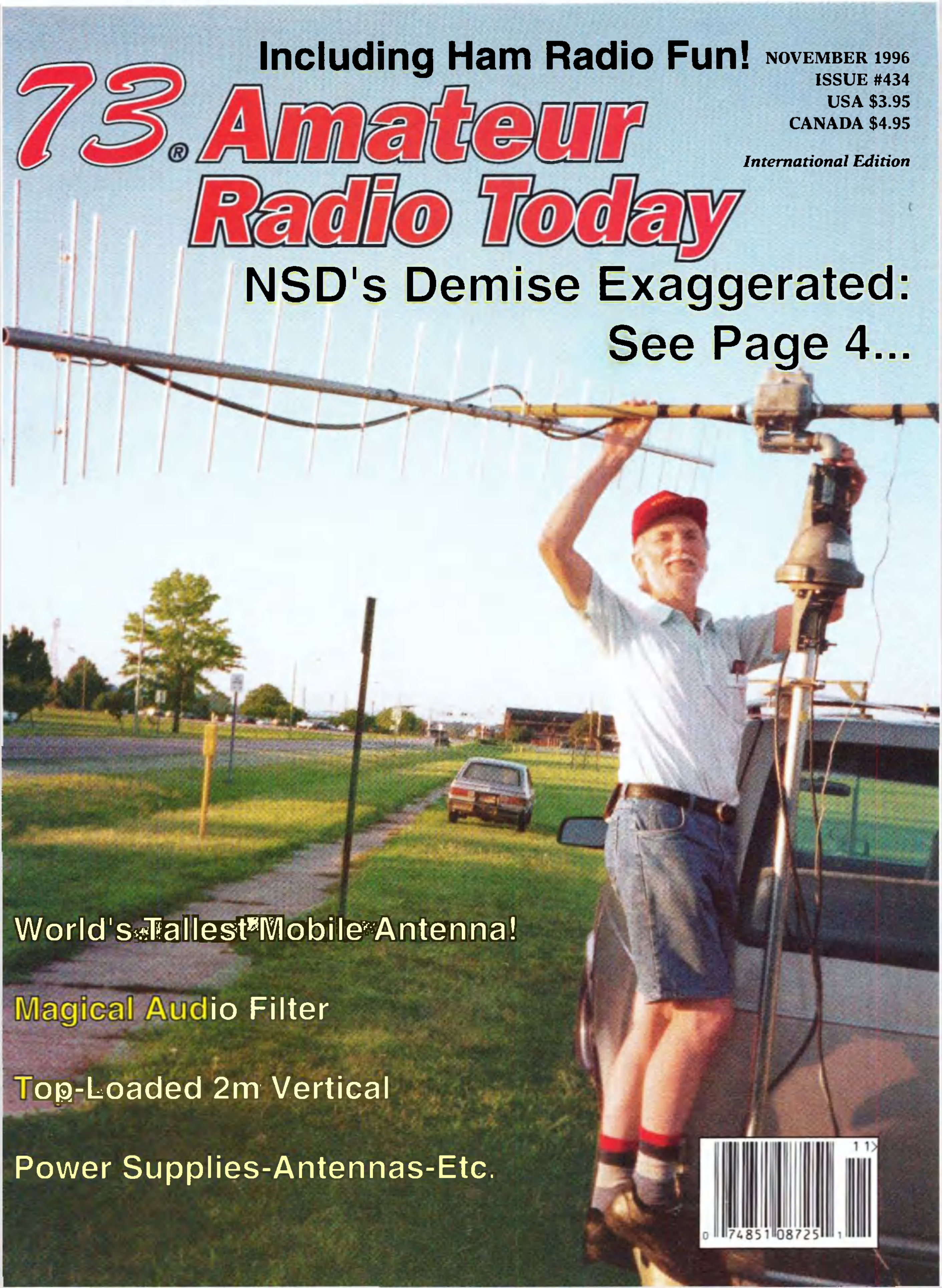
See Page 4...



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Including Ham Radio Fun!

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HAM RADIO FUN SECTION

On the cover: Roger Grady K9OPO readies the ATV ground station to track the WindTrax balloon flight (see page 46). Photo by Bill Brown WB8ELK.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Contract: Reading this constitutes your agreement to, within a fortnight, share with at least one non-amateur the thrill of your first days as a ham. Or, if you aren't yet a ham, find one to share his/her story with you. It's contagious.

Number 1 on your Feedback card

Never say die

Wayne Green W2NSD/1

Tampa: November 23rd

Yep, controversial Wayne Green speaketh! Come see what all the fuss is about. From noon until 2 p.m. at the Tampa Hamfest I'll be talking a blue streak and answering questions. On anything, so come armed. Yes, I'll talk about the possible futures for the hobby. Yes, I'll talk about religious issues such as CW. Yes, I'll talk about the hobby going to hell in a handbasket. Yes, I'll talk about the adventures amateur radio affords, and the excitement that pioneering new modes provides. Yes, I'll explain the secret for making all the money you want. Yes, I'll talk about how you can add at least 20-30 years to your life, if you're interested. These are exciting times, with cold fusion emerging as a new power source, with new discoveries about water, magnetism, health maintenance and repair, the mind and its repair, aliens, UFOs and other ridiculous stuff getting more real as you look into them.

Yes, I'll explain about some of the exciting books you can read to get your mind working again. Did NASA really fake the moon landings or has Wayne been conned by a clever new book? Have there really been highly advanced past civilizations? Do you have any understanding of how digital radio and television are going to change things? And how you may be able to benefit in a big way from these changes? There are billions to be made in these emerging technologies. Are you just going to passively watch it all happen, or will you get in there and help?

Bill Gates was there first with microcomputer software. Steve Jobs was there first with a single-board computer. They've done fairly well as a result. They saw opportunities and actually did something about them. Motivation. Determination. Perseverance. Never Say Die! Okay?

Hey, don't forget to have lunch early so I won't have to listen to your stomachs growling. Besides, that'll help me put you to sleep.

An Engineer Shortage?

Between an article in the *L.A. Times* and a recent PBS show, my contention that there is a desperate need for engineers has been confirmed. The *Times* article went into detail on the lengths some companies are having to go in their search for engineers. Like the California company that heard about an engineering department in Florida being downsized. They hired the engineers, setting up an office for them in Boca Raton so they wouldn't have to relocate. They then set up a communications system so they could be in close touch with the home office.

Well, we know that more and more software firms are farming out their work on contract to companies in India and Pakistan.

More and more Silicon Valley firms are hiring Chinese. Indeed, some have whole Chinese departments, where many meetings are conducted in Chinese. That makes sense since Asians, on the average, have about a 10-point IQ advantage (yes, they're smarter than us), plus they have an incredibly strong work ethic, something we've managed to virtually eliminate in American youngsters. And the US, compared to life in China, is a golden land of opportunity where hard work and skills pay off.

My proposal is to use amateur radio as a way to interest our kids in electronics so we'll have more American engineers, technicians and scientists in the next century. Alas, few kids today even know amateur radio exists. Our ham clubs, with few exceptions, are making little effort to generate more hams. Does your club get announcements of meetings and other activities listed in the local papers? Has your club made an effort to sponsor radio clubs in local schools? Has your club donated ham magazine subscriptions to local school libraries?

When I got interested in amateur radio the first place I went to was the school library. There I found a really great magazine, *Radio*. It got me fired up to start building ham equipment.

When I give talks to kids in the 5th and 6th grades they get all excited about our hobby. They know about CB, but that's old stuff now. Few have ever even heard about what we're doing. How long are you going to keep ignoring our (your) kids?

Heck, if they start automating our fast food restaurants a whole generation of kids will be unemployed. Hmm, let's see, now if we combined the old Automat system with a microwave for each food slot, customers could get hot sandwiches and stuff without any counter help. And the sandwiches could be precooked and assembled in factories by machines ...

Tech Update

The AIDS cure I described in my February editorial hasn't hit *Time* yet, but it is finally getting published in some medical journals, so the word is starting to get around.

I sent letters to my two senators and representatives in Washington, asking if they were interested in the AIDS cure. One answered, saying I should get in touch with the FDA if I had a problem. So I wrote to the head of the FDA and to the Health cabinet member. You guessed it, after six months, no answer. I also wrote to the editors of *Time, Newsweek, US News, Forbes, Fortune*, and a few other magazines. No answer from any of them.

Is it that no one of importance reads their mail anymore? I read mine, but then I don't count as a person of importance, except in my own mind.

I see that TNT is going to broadcast a film on Amelia Earhart. Well, they haven't contacted me, and as far as I know, I'm one of the few people alive who knows the inside story of her last trip. Frankly, I'm disappointed in you. I've written about this and you haven't passed the word. So I watched the recent TV program about Amelia blunder around, and ditto the author of the recent Earhart book. Tsk. Hey, she was a spy for the Navy, and I knew it *before* she made her trip, as I've explained.

I've been hoping to get some people in Congress interested in the cold fusion developments. I've had every bit as much success in getting answers on that subject. Things have been moving fast in the cold fusion department. The University of Siena, Italy, demonstrated a nickel-hydrogen system which generated lots of power and kept on doing it for weeks after all input was removed. It didn't stop by itself, they had to stop it. This is particularly interesting in that the reaction has been at relatively high temperatures (around 500°F), so it's a more efficient system. The estimates I've seen are on the order of 300 kilowatts from three grams of nickel. The university has not been forthcoming on their system for initiating the reaction, but from the pictures I've seen it doesn't look very complicated. This is obviously not a chemical reaction.

Cold fusion presents a wonderful opportunity for experimenters. First, it doesn't cost a bundle to experiment in the field. Second, it doesn't take a Ph.D. in chemistry or physics, or anything else, for that matter. This is a whole new field and there are few experts yet. You could be one, if you wanted. Third, all of the research in this field so far has been empirical, which means everyone involved is trying this and that, and seeing what works and what doesn't.

Pons and Fleischmann got started with this because they'd run across an anomaly that

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LETTERS

From the Ham Shack

Elmer Sinclair KD4JUH. This was prompted by the reading of K9KPM's piece on the May "Ham to Ham" page. Since deciding late in life to get a ham ticket, I have had a fruitless though amusing time looking for the origin of the term "PEP." In explaining it, all references I've found in the amateur radio literature, as well as the answers I've received by raising the question, have reverted to the classical explanation of power using rms values of voltage and current. Some explanations confuse me by carelessly using terms such as "average" when "effective" is meant. The average value of a sinusoidal current is zero; the effective (rms) value is that which will produce the same heating effect in a resistor in the same given time as a DC current of the same value. By deduction, the same is true of a sinusoidal voltage, because V=iR. But i= Q/t, which is a certain charge moving past a given point in a certain time "t"; the standard value of "t" is one second. Furthermore, since power is a function of current, it also has a time component, namely the same one as "i." So what is the meaning of "peak" when used in conjunction with power, as in "PEP"? If it is an event having a time span of less than one second, what is the unit for PEP? If it can be defined with more traditional terms, why don't we?

Troublemaker ... Wayne.

Stephen Early NØSHT. The FCC has been lobbied heavily by a small group of hams who advocate the perpetuation of the Morse code requirements for operators on frequencies below 30 MHz (RR2735). The same group appears to also be upset with the no-code licenses. But without the no-coders the hobby was slowly dying. These new hams are not organized, therefore they have no voice. If the old-timers think the code is so critical, we should have proficiency tests for their license renewal. How about polling the newcomers on the value of the code test?

First, I checked the Callbook to make sure my leg wasn't being pulled by the call. That's a call I'd pay good money for. Look, Stephen, the ARRL is going to do whatever it takes to preserve the code test. The League directors I've known have always said that Novices and Techs aren't really hams, so you can bet their interests are not being considered. A high percentage of the no-coders do not read any ham magazine. Too technical. They aren't interested, by and large, in upgrading. 2m repeaters beats the heck out of CB, and that's that ... Wayne.

Mike Carbaugh WA3HDQ. I've had my ticket since the 10th grade, in 1967. I worked a lot of 6m AM and 2m FM back when 2m was fun. It seems like nowadays each repeater has its own little "group," but I still use an HT in my car during my 52-mile daily commute. I faded away from hamming in the late '70s, but came back when Techs got 10m. I'm using a 40m dipole, thanks to an article in your magazine. I just bought a PK-88 TNC and am looking for a PC. I joined AMSAT and listen to the "birds." The 2m/10m crosslink repeaters are a lot of fun. Try them, if there are any in your area. Clubs should do more for newer hams, and let them do some operating on Field Day, and during contests and special events. And cut down on the business meetings!

On my last 125 10m contacts, 63 were Novice or Tech, 20 were Generals, 24 Advanced, and 18 Extras. Techs seem to have revived activity on the band. I agree with you, and so do many other silent hams: To hell with the code! It's holding many good potential hams back.

If readers will send in a list of the repeaters which offer crossband contacts, I'd love to print a list. Give me the input channel, any coding required, and output crossband frequencies. Back in 1970 my WR1AAB repeater could be toggled to 6m or 10m by users, and it was a ball to use ... Wayne.

Larry Pitt KBØMOT. Wayne, I like your editorials, but I disagree with your comments on the code requirements for the General license. I'm a Tech-Plus, after starting as a no-code Tech. I'll soon be a General. I enjoy the challenge of the code. Don't make the ticket an easy thing to get. I like CW and have purchased a Bencher paddle and top-of-the-line MFJ keyer. I'll bet this letter won't be in the magazine.

You lose! CW is fun and thousands of hams are having a great time using it. But at a time when we are desperate for more hams, the artificial barrier to the hobby could lose everything for us. So let's get in as many newcomers as we can and then sell them on the fun of using the code. You apparently have no problem with the government telling you what to do, whether it makes sense in view of today's technology or not. I am a big fan of small government, and a minimum of it telling us what we have to do. And, other than being a fun mode of communications for us, CW has little else to offer these days. It's as out of date as spark and smoke signals. When I first got on the air in 1938 95% of all ham contacts were via CW. The latest estimates put CW activity at about 5% ... Wayne.

Pete Theiler KI4KN. I always enjoy reading your editorials and, based on your recommendations, I have been reading about the influences of electric and magnetic fields on life processes. Years ago, a friend of mine in Europe used a device that passed a minute electric current (on the order of 50-200 µA) through the body. This was simply a battery, pot, and electrodes. I think it was a commercial device. My friend suffered from fainting spells and other disorders. He swore the device helped him by stimulating his blood circulation and that it also speeded up healing. I had not taken any of this too seriously until I began to read Dr. Becker's *Cross Currents* and decided that there may be something to it. Thanks for your help and keep giving us hell in your editorials; most of us are just too complacent.

Bob Beck's latest claims are that he has over 200 authenti-

cated AIDS cures, with no known failures so far. But is this enough to interest AIDS activists? No, let's budget a few more hundreds of millions of government money into research for a drug cure ... Wayne.

Ken Young KD4WXW. I have been reading your editorials for a year or so and agree with many of your ideas and suggestions. I'm 15 and have had my license for several years now, but my friends in high school don't really understand anything about our hobby. Last year I decided to start a radio club for my high school and I've managed to get several members. I now have the respect of my classmates and teachers. Do you have any ideas to help attract attention to the club and help build its growth? I love your magazine, especially the antenna construction articles and editorials. Keep it up.

Thanks, Ken, and of course I have ideas on how to build the club. #1 is promotion, and that means articles, letters, meeting notices, activity reports in the school paper, on the school bulletin board, the local newspaper, TV and radio stations. Your members will do more if they're asked to and it's fun. Get any ham manufacturers or dealers in the area to come and talk. Club meetings are show biz where you get local hams active on packet, satellites, DXing, etc., to come and talk. Keep the business part of the meetings to a maximum of 10 minutes. There, that ought to keep you busy. Report back on progress ... Wayne.

Charles Leggatt VE3CFL. Bringing your readers up to date, May of 1997 will be the 500th anniversary of Giovani Caboto's sail from Bristol, England, to find the lands of the Great Khan. This was two years after Columbus had sailed south and discovered the Caribbean Islands, so it was a time of considerable interest in trying to find a sea route to China and the wealth that its silk trade could bring. There is no written proof of where he actually landed, but Newfoundland claims the honor, so that is that.

What is interesting about the area of Newfoundland and Labrador is that 200 years before the Pilgrim fathers set foot in America there was a community of some 1,300 souls who set up a whaling community in Labrador to process whale blubber. After several years, when it became no longer viable, they left, and only their big iron pots are left to remind us of their history. Since no effort was made to plant a flag and claim the land, it remained to be officially discovered.

The British, as you may have heard, have built a replica of Caboto's vessel, *The Matthew*. It has been undergoing sea trials for some months now and seems to be able to take a good bashing without sinking. It will set sail from Bristol, England, in May 1997, its destination Bonavista, Newfoundland. There will be 45 days of celebration with *The Matthew* circumnavigating the island. After that, it will proceed to the U.S.A. for further celebrations. The Cabot family tree extends to the U.S.A., and perhaps the most obvious member is your famous Cabot-Lodge.

What is Canada doing? Well, to start with, Newfoundland has really gone all out to prepare for *The Matthew*'s arrival. The Brits held a wonderful week of festivities in Bristol called The Festival of the Sea. Including Canada, five nations were represented and more than seven hundred vessels from all over the world were huddled in Bristol Harbor. Newfoundland, the Brits told us, had the best contingent of all the countries visiting, and since I was there, I can vouch for their correctness.

In Toronto, just under two years ago, a couple of Toronto sailors, Robert O'Brien of the National Yacht Club and John Dunford from the Mimico Cruising Club (both ex-Newfoundlanders), decided it would be a grand idea to get together a bunch of fellow sailors and sail the 1,900

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QRX . . .

Number 8 on your Feedback card

Caught In the Web

Kenwood Communications Corporation now offers an extensive FTP site that includes many Kenwood service bulletins and application notes dating back to 1975. A complete file directory is available at http://www.kenwood.net, or visit the site directly at ftp://ftp.kenwood.net.

Hams Turn Out In Airline Disaster

Some 125 Hams from the Greater New York City/Long Island vicinity contributed more than 2500 volunteer hours to support recovery operations in the wake of the TWA Flight 800 disaster on July 17.

The New York City Red Cross originally requested communication to Suffolk, which was arranged on UHF, linking Nassau and Suffolk Counties and New York City. A call also went out to Sid Wolen K2LJH, of Azden in New Hyde Park, New York, to supply additional radios, which the company was able to do.

As the situation developed, the Red Cross's mission became feeding the 2000 to 3000 rescue workers at the "crash site" (US Coast Guard Station) and to provide mental health support for the workers and the victims' families. The local telephone company, NYNEX, donated cell phones, but these initially were useless, with 3000 rescue workers and thousands of members of the press severely overloading the local cell. NYNEX set up a high-capacity site the second day, but that had its limitations also.

Ham radio worked, however, and ARES organizations were able to provide communications links between the American Red Cross HQ in Yaphank, New York, the lead Red Cross official at the site, and the Red Cross official at the morgue.

Although the recovery efforts continue, amateur radio support concluded during the last weekend in July.

Walt Wenzel KA2RGI, of the Region IV RACES, offered some lessons learned during the support effort. Among them:

You can't always count on 2m repeaters alone to provide coverage (the Flight 800 recovery effort, in fact, relied on a 70cm repeater).

ECs should keep a database of available equipment that can be loaned to operators who turn out.

Prospective volunteers should be reminded that while duty shifts are usually eight hours, they can often be 10 or 12 hours long. "People have to remember that having two batteries does not mean they have long-term power for handhelds," said Wenzel.

Coordination among ECs is key to success and individual volunteers must also coordinate their involvement with those in charge and not "just show up to assist." Volunteers also should not make statements to the media as this just adds to the confusion.

Even those with little or no public service experience can be valuable in an emergency situation, Wenzel said. "Do not think because you have not been involved for long with emergency communications or amateur radio that you cannot assist," he said. "Most people that can assist are new and are learning, and if you have checked into club nets and ARES or RACES nets, then you have the basics needed to assist." From *Harmonics*, official publication of the South Jersey Radio Association.

Newly Discovered Computer Viruses

•FEDERAL BUREAUCRAT VIRUS: Divides your hard disk into hundreds of little units, each of which does practically nothing, but all of which claim to be the most important part of your computer.

•PAT BUCHANAN VIRUS: Your system works fine, but it complains loudly about foreign software.

•PBS VIRUS: Your programs stop every few minutes to ask for money.

•ELVIS VIRUS: Your computer gets fat, slow, and lazy, then self-destructs, only to resurface at shopping malls and service stations across rural America.

•ROSS PEROT VIRUS: Activates every component in your system, just before the whole thing quits. Then space aliens land at your daughter's wedding.

Lifted from *The Open Squelch*, official newsletter of the Van Wert Amateur Radio Club.

It's a Bird! It's a Plane! No, it's...

A joint AMSAT-Germany/AMSAT-North America presentation in July announced that the next ESA (European Space Agency) Ariane 5 mission, AR 502, launch will be carrying AMSAT's Phase 3-D International Satellite.

After the failure of the first Ariane 5 launch in June, a board of inquiry presented the ESA with recommendations that should be considered for the next mission. Dr. Meinzer, Phase 3-D project leader, was quoted saying, "We have been given strong assurances that ESA has taken the recommendations of the AR 501 Inquiry Board to heart and are now 'rolling up their shirtsleeves' to correct those deficiencies in time for the Ariane 502 launch. I am sure that the ESA will do all that can possibly be done to insure our launch is successful."

AMSAT is committed to promoting space and communication research by constructing and controlling amateur radio spacecraft. It is a non-profit organization that has been employing volunteer labor and using donated materials and services along with governmental assistance for over twenty-five years. To date it has launched over two dozen communications satellites.

From *AMSAT News Release* #96-05.

Generous QRPers

One quietly altruistic event during the fun of the "Four Days in May" at Dayton this year was the collection of several hundred dollars to purchase solar panels for lighting in a small, very poor village in El Salvador. The panels will be taken to El Salvador this winter by Jo-Anna Dobbs GØOWH, who will spend a month working with a support group for the village. Mrs. Dobbs, wife of Rev. George Dobbs G3RJV, of Lancashire, England, takes unpaid work leave and provides her own fare. All funds raised by the support group go directly to the village, for primary health care and co-operative production.

Also, for many years, usually unknown to members, the G-QRP Club has sent free *SPRATs*, books and parts to many people in the third world who want to be involved in amateur radio but lack the funds. This year, in conjunction with NorCal, the G-QRP Club plans to ship 20 Epiphyte SSB kits to Asia for young amateurs who cannot buy equipment. Current plans are to ship kits to India and Pakistan, but suggestions from overseas members about other potential recipients are welcome.

Taken from an editorial by Rev. George Dobbs G3RJV, in *SPRAT, The Journal of the G-QRP Club.*

Radio Lollipop

Miami Children's Hospital has the first in-hospital pediatric radio station in the country: *Radio Lollipop*, staffed by volunteers, hospital staff, and patients, will broadcast live from a booth adjacent to the Child Life Playroom.

"*Radio Lollipop* provides hospitalized children with a way to escape the boundaries of illness by using their imaginations and becoming active participants in programming," says Renay Blanchette Rouse, project manager. The children will be able to take part in the programs, choose records, or answer quizzes by using special phones from their bedsides.

Radio Lollipop is an international not-for-profit organization established in 16 major children's hospitals around the world, including Great Britain, Australia, and New Zealand. It was first launched in 1979.

NEVER SAY DIE

Continued from page 4

seemed worth checking out when palladium and deuterium were put in a lithium bath. It was much the same with Hydrosonics in Georgia, which has been manufacturing steam heating systems that use a new approach to water compression to heat the water. Then their customers started remarking on how efficient their systems were, so they tested one and found it was more than 100% efficient. Hey, what's going on here?

What fields have you become an expert in? For that matter, what have you done with your life that has contributed even a little bit to the advancement of society? One of the things that really disappointed me when I started going to the reunions of my old submarine buddies from WWII was that few of them had ever done anything of any significance since our time on the submarine. Indeed, that was the most important thing many of them have ever done.

It just isn't that difficult to become an expert in some field. In almost any field. When the microcomputer came along in 1975 I decided I'd have to learn how the darned things worked. I went out and bought a stack of books on computer theory and started reading. When I found them almost impossible to understand (they were terrible ... college texts), that gave me the idea to start *Byte*. I knew there would be hundreds of thousands of people in the same fix as a result of this revolutionary development.

No one knows yet how cold fusion actually works, so anyone new to the field is starting out fresh. Actually, a newcomer has an advantage. One of the things that has hurt cold fusion has been the know-nothing scientists who, because they don't have an explanation for what's happening, have been refusing to believe it. Their position is that every one of the research labs that has claimed positive results has made serious errors. It can't happen. It hasn't happened. Everyone is mistaken. One scientist, Professor John Huizenga of the University of Rochester, and one journalist, Gary Taubs, have staked their reputations on this with books they've published.

Amateurs have a great advantage in that they aren't limited by what they know, only by what they don't know.

So the next time you start reading about digital voice, digital data compression, video compression, or a crypto algorithm, don't blonk out your eyes like that stupid old orphan and her 70-year-old dog; put on your pioneer hat and head for the hills of learning. How's that for some creative clichés? Blonk that metaphor!

Black & White

I'll bet you didn't know that the argot spoken by blacks was originally a white language. That's right, what is now spoken by our uneducated poor blacks came over from the south and west of England in the 17th

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Number 10 on your Feedback card

Switching Power Supplies

Different Is Good!

Dave Miller NZ9E
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Niles IL 60714-3108

Let's review: An AC line operated linear supply normally consists of a step-up or step-down power transformer, followed by a diode rectifier, dual-diode rectifier pair, or a four-diode bridge rectifier package. The transformer's output voltage is applied to the rectifier circuit and the pulsating DC output from the rectifier is then sent on to be filtered by an RC (resistor/capacitor) or an LC (inductor/capacitor) filter section. The resulting voltage is then either used directly, or further processed by one of the many solid-state regulator circuits that are available to the equipment designer today. The entire process is easy for most of us to picture, and entirely linear (non-digital) in its makeup. This is the typical power supply that we've all learned to build and troubleshoot.

But just when you thought that you had it all down pat, along comes those new "switching power supplies" to add confusion! What gives? Is this just someone's brainchild to make life complicated, or are there real-life advantages to switching supplies?

As it turns out, switching power supplies really do have several advantages going for them. Traditional linear supplies are shamefully inefficient. They're often 50% (or less) efficient! That means that only half (sometimes less) of the input power is converted into the operational power needed by the device being run from the supply and the rest is dissipated as heat. One reason for this high level of inefficiency lies in the amount of "overhead" voltage necessary (the over- voltage needed ahead of the regulator circuit to make sure that it maintains regulation over widely fluctuating current demands). Another is the difficulty (and expense) in designing an efficient 60 Hz power conversion transformer. By contrast, switching supplies can be designed to be 85% efficient or better, resulting in considerably less heat loss and in less need for robust components within the supply to dissipate that heat. Switching supplies are smarter, smaller, lighter, and produce less wasted heat than do their linear counterparts.

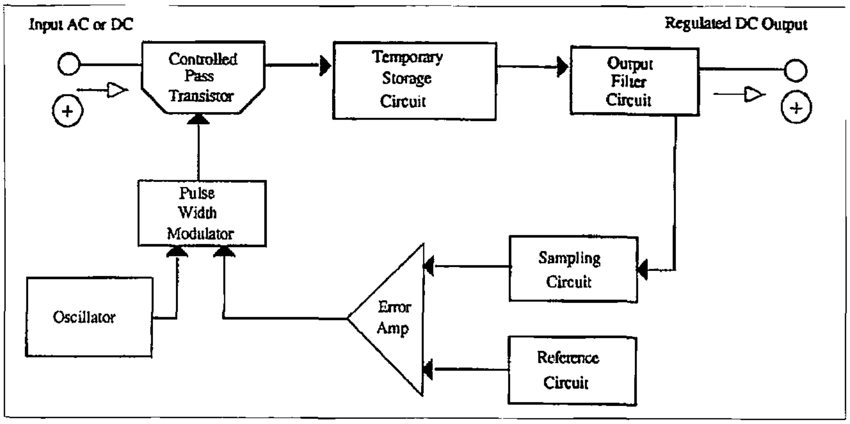

Fig. 1. The block diagram of a switching power supply.

But that's not all!

There are additional advantages to switching supplies. They'll operate over a greater range of voltages and currents than will a linear supply; the input voltage can actually be lower than the output voltage; and the output voltage can be of the opposite polarity from the input voltage. These last two features are not even *possible* with true linear supplies.

How is all of this accomplished? It's getting more and more important for all of us to know how, because switching supplies are showing up more frequently in computers, video monitors, consumer electronics, and of course, amateur gear. In order to be able to troubleshoot switching supplies when something goes awry, we have to at least be minimally familiar with the theory of operation of these relatively new devices, so here we go. Follow along with the help of the block diagram in **Fig. 1** while we explore the various elements that make up an average switching supply—it's not all that tough—just a different way of looking at power supplies.

The nitty-gritties

It's easiest if we begin with a slightly different mindset than when we're thinking about linear supplies. Instead of actual voltages and currents, I'll be using the term "energy" (which is what voltage and current really is) and then view what happens to this energy in terms of circuit "blocks" instead of tracking the electrons though each component part. I think that it makes it easier to picture what's happening.

The input rectified line voltage is first introduced into a controlled pass transistor block (shown in **Fig. 1**), much like a pass transistor regulator circuit in a linear supply. Immediately following the control device is a temporary storage circuit. It consists of an inductor, a capacitor and a diode. The temporary storage section is important, and something of a deviation from what we normally think of as the typical filtering section in a linear supply. To understand what happens, cast your mind back to Electronics 101: An inductor opposes any change in current (by developing a counter EMF) and is able to store energy within its own magnetic field. If neither of these properties of inductors sounds particularly familiar to you, you might want to go back and study up a bit on inductors in any basic electronics text, or you can simply take them on faith, but it's important to keep them in mind when analyzing how a switching supply does what it does.

Basically, when an inductor begins to carry current, its counter EMF opposes the change, causing the current to increase at a logarithmic rate, rather than all at once. The same effect is true in reverse; when the inductor is giving up its energy, there's a "reluctance" to the change, and the decrease is likewise at a logarithmic rate. This permits the inductor to store and release energy at a naturally controlled rate and facilitates the action of the switching power circuitry.

Jump over to **Fig. 2** momentarily. Once the supply is operational and the inductor has built up a magnetic field around itself, it supplies the energy stored in its magnetic field to the capacitor which acts as a reservoir for that energy, holding it until it's needed by the load (the device being powered). So the inductor and capacitor work in tandem, building up the energy to the level deemed necessary in the design, temporarily storing it, then releasing it as needed into the circuitry being powered in a controlled fashion. The diode in **Fig. 2** simply provides the directional path for current flow.

"These last two features are not even* possible *with true linear supplies."

Now, here's the neat part:

The control element that I mentioned earlier determines how much energy will be permitted to build up within the temporary storage circuit, based upon the demands of the final load circuitry. It does this by monitoring the "ideal" design energy level, and then automatically adjusting the control element to permit more or less energy into the storage block, based upon that design ideal. Unlike the normal regulator circuit in a linear power supply, however, the control element in a switching supply pulses the pass transistor on and off, many times each second, and varies the duration (or duty cycle) of those pulses, to match the energy level needed by the final circuitry being powered. It's called pulse-width modulation and it can react very quickly and efficiently to meter the amount of energy permitted to pass through the temporary storage block, all within fractions of a second.

Going back to **Fig. 1**, we see that the output of the temporary storage circuit is fed into an output filter circuit (or block) and on to the load. But a sampling of the output is also fed into an error amp, along with a reference voltage. A reference oscillator's output is fed to the pulse width modulator and used to determine the number of pulses sent to the control element each second. An error voltage from the output sampling and reference circuit blocks is also fed into the pulse width modulator and used to determine exactly how wide those pulses will be. It's similar to a phase-locked loop in a digital frequency synthesizer in some respects, but the analogy shouldn't be carried too far. A switching power supply is unique, but not completely unlike other circuitry common in ham gear these days.

It's important to remember that the output sampling block, the feedback block, and the reference oscillator block all exist to inform the control element how much outside energy to permit into the storage loop block at any instant in time. Thinking in these terms requires that mindset mentioned earlier—somewhat different than when analyzing how a conventional linear power supply works. The pulse-width modulation (or duty-cycle modulation) places the theory of a switching supply more into the digital domain than in the linear or analog domain. The control element of the supply is pulsed on and off, using pulses of varying duration, rather than a continuous and smoothly varying sampling voltage as in a linear supply. Perhaps now you can agree why looking at a switching power supply in terms of blocks or sections is easier to visualize. Since switching supplies are somewhat complex, breaking the supply down into these categories lessens the confusion that might otherwise result when first looking at the schematic diagram of

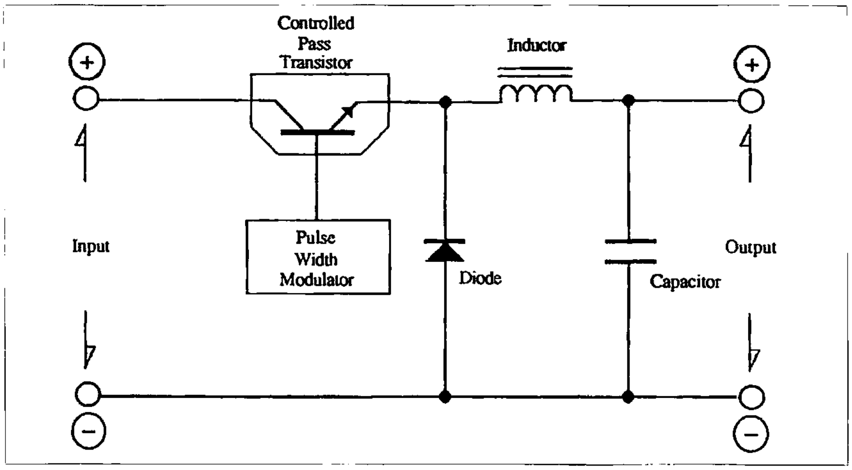

Fig. 2. In this step-down circuit, the output voltage is lower than the input voltage by a given amount and the output is primarily supplied by the discharging of the capacitor, with some additional energy supplied by the inductor as needed, but the inductor's main function is to replenish the charge on the capacitor.

one of these odd-looking ducks. Thinking in terms of blocks or sections also can be helpful in troubleshooting a switching supply—by examining what is and what is not present—in terms of all of the necessary elements.

The three basic types

Getting back to some of the details now, I mentioned earlier that a switching supply can either step up or step down the input voltage, even if the input voltage is lower than the desired output voltage. Stepping down is easiest to see; when the supply is operating normally, energy stored in the inductor's magnetic field and in the capacitor's dielectric is supplied to the output load circuitry via the capacitor's discharging—with the inductor recharging the capacitor as well as supplying some of the load current itself. Remember also that the temporary storage section component configuration in **Fig. 2** is used for this purpose. When stepping up the output voltage, however, the temporary storage section is configured somewhat differently (see **Fig. 3**), with the result that the inductor's energy is summed with the capacitor's energy, in a circuit that's reminiscent of the classical cascaded voltage doubler circuit. That configuration results in a higher voltage on the output than was present on the input for low current demand applications. When polarity inversion is called for, the control and storage elements are configured differently again (see **Fig. 4**), resulting in the positive and negative sense changing positions between the input and output. It does this by allowing the inductor to reverse charge the capacitor. Once again, **Fig. 2, 3** and **4** show each of the three possible conditions and the basic control/storage element configurations needed to achieve them.

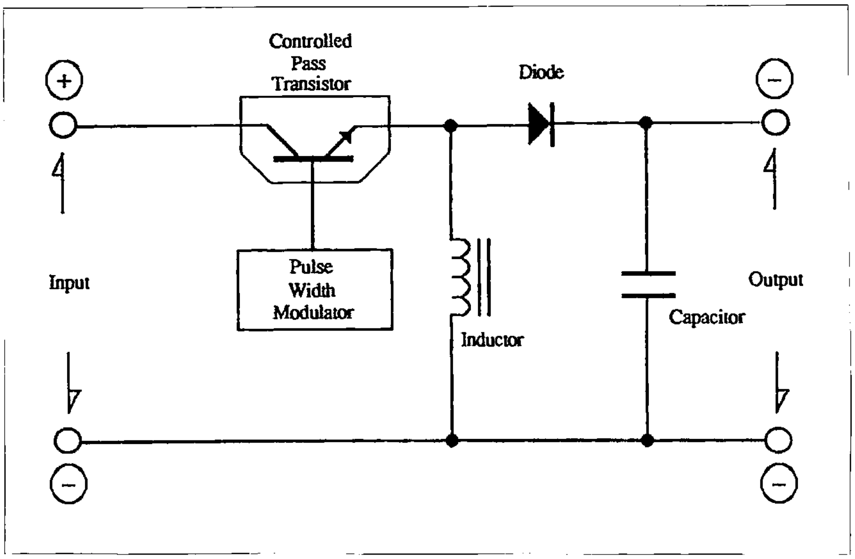

Fig. 4. *This polarity inverting circuit functions as a "flyback" circuit, supplying energy from both the inductor and the capacitor, but with the inductor charging the capacitor in a reverse direction from the input polarity sense. An inverting circuit like the one shown can be either step-up or step-down in terms of the final amount of output voltage.*

A somewhat different approach

Another variation on the switching power supply, one that finds its home in higher current applications (such as might be found when powering a typical 100 W amateur HF transceiver), is shown in **Fig. 5**. Instead of using a relatively heavy and inefficient 120V to low-voltage-transformer (as older linear supplies would do), this line-voltage-to-14V supply first rectifies the 120 volts, filters it, and applies the high-DC line voltage to a pair of transistor driver stages. These driver stages are switched on and off at a high frequency (controlled by the driver oscillator) and this high-frequency pulsating DC then is stepped down to a high-current, low-voltage DC by a more efficient high-frequency transformer and a pair of high-current switching diodes. The advantage is a much lighter, smaller, more efficient transformer, and considerably easier to filter high-frequency pulsating DC. Better control over the amount of input energy is also possible by utilizing pulse modulation control circuitry as discussed before.

"The square waves generated in digital switching are rich in harmonic content."

The reduction in size and weight by using high frequency switching—as opposed to the 60 Hz line frequency

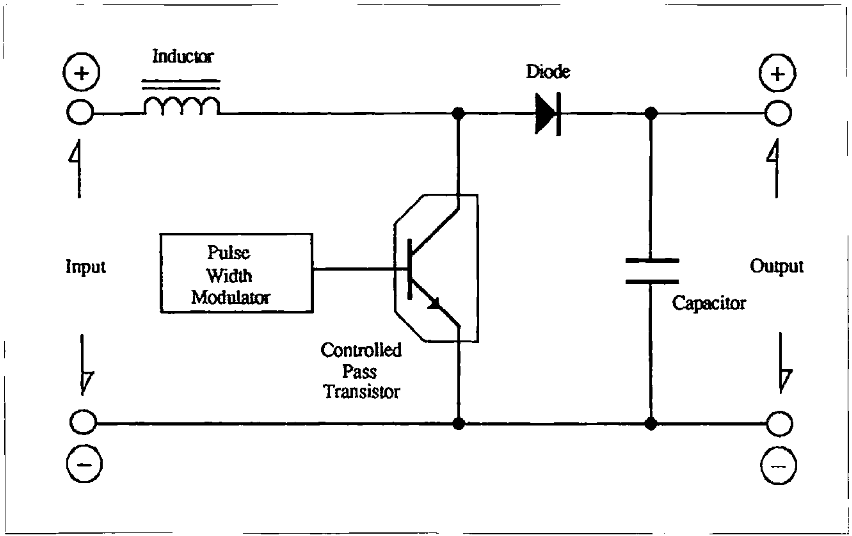

Fig. 3. *In this step-up circuit, the output voltage is higher by a given amount than the input voltage, since it consists of the cumulative total of the energy supplied by both the inductor and the capacitor.*

LETTERS

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nautical miles to Newfoundland to meet up with *The Matthew* when it arrives in Bonavista. They called themselves "The Newfoundland Flotilla '97," and set about finding a few sailors who would be willing to brave the mighty St. Lawrence River and join them in the adventure. Well, they have certainly been successful, because at the time of writing some 76 sailors have signed up to be part of the Flotilla. This does not include some 25 American sailors who want to join the Flotilla in Bonavista. The Toronto Italian community is also involved, and they are considering a commitment to obtaining one hundred Flotilla sponsors at $10,000 apiece, the proceeds going to charity. The City of Toronto is sponsoring the Newfoundland Flotilla '97 Log Book, and all the skippers will be invited to City Hall for a luncheon and presentation of the Log Books just prior to their departure.

What about the ham side of things? Well, over a year ago I decided that a venture such as the Newfoundland Flotilla had to have a Chief Radio Officer and he could not qualify for that high title unless he could arrange a Special Events callsign. So I started with the Canadian Government Department of Communications. They naturally wanted full historical information, which was supplied, and then I waited. After a long wait, I phoned and asked why the delay, and was told that they thought that this was the first time in Canadian radio history that a maritime mobile unit had asked for a Special Events callsign. You see, Ontario's callsigns start with either VE or VA, followed by the number 3. Quebec has the number 2, the Maritime Provinces number 1, and Newfoundland starts with VO, not VE or VA. The Canadian Feds had to write to each of those Provinces and ask them to allow the Flotilla to pass through their territory without having to change the Special Events callsign. They got the Provinces to agree, and the Flotilla, when it sails in the May of '97, will do so with the callsign "CF3NYC." We have not set up a frequency and transmission time schedule yet, but that will be settled in the next two to three months.

If any of your readers want to find out more about the Newfoundland Flotilla '97 they can write to: Robert O'Brien, Chairman Newfoundland Flotilla '97, c/o National Yacht Club, 1 Stadium Road, Toronto, Ontario, Canada M5V 3H4. Or, E-mail: NFFLOTIL97@aol.com. CompuServe is: 75333,3243 @compuserve.com. There is a host of information available through these two mediums, so go to it. If there are any vessels who want to join the Flotilla write soon and get on the mailing list.

Darn, I sold my yacht! ... Wayne.

Bill Riley K9IMG. I enjoy reading your "Never Say Die" column. Recently, you mentioned the Council of La Raza, and that you did not know who they were. Another identical group is The Council por la Causa. These are Hispanic (Mexican) lobby groups that aim to get more federal funds.

They send their members to lobby the federal and state governments for more money, based upon their facts showing discrimination and a need for more and cheaper housing, housing repair, LIEAP (Low Income Energy Assistance Program) money, food banks, medical care, prenatal care, bilingual education, Head Start, ad infinitum. Our liberal Congress dutifully allocates more money. The federal agencies HUD, FEMA and DHSS collaborate with the Hispanics so they know exactly how to apply for these federal funds. The local agencies disburse the money, keeping 10% for administrative costs. This local agency can be a community action council, a council of government, immigrant services, or one of a number of peace and social justice coalitions.

These local agencies, always headed by a liberal activist Democrat, have a liberal activist Democrat staff that are all paid big salaries with a full range of benefits, even though most

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switching—is quite dramatic, making for much more portability in high current supplies. One tradeoff that should be mentioned, however, is the potential for RFI from the power supply itself, especially when used near ham radio gear. This is true of all of the supplies talked about so far. The square waves generated in digital switching are rich in harmonic content; it's just a fact of life in the digital domain. Switching power supplies must be well designed, well constructed, and well shielded if operation near radio reception equipment is anticipated. Recognized name-brand supplies usually take every precaution in this area, but some RFI may still be experienced, just as with any other digital circuitry. Modern ferrite devices are generally used to help keep RFI from becoming an overwhelming concern, and all shielding must be replaced when these supplies are reinstated after troubleshooting.

Another difference between switching power supplies and their linear counterparts is in their cost; switching supplies are often 2 to 3 times more expensive because of the additional circuit complication and RFI proofing that's needed. There's a price for smaller size and greater efficiency, but it's often worth it.

Troubleshooting considerations

When troubleshooting a switching vs. a linear supply, the switching supply is much more difficult to analyze for faults. It's almost imperative that a schematic diagram be available; and a "theory of operation" and voltage chart can also be real timesavers. The best way to approach the problem is stage by stage. Try to isolate the fault on the basis of which stage, then which component in that stage, is behaving incorrectly. With the feedback loops at work, it's sometimes difficult to make that determination in a switching supply. If that's the case, try to analyze how the feedback loop can be interrupted and replaced with a fixed reference supply instead, just for the time being, until the problem can be isolated and corrected. This approach is sometimes the only way to avoid chasing your tail when working on any circuit that contains service-defying feedback stages.

"This approach is sometimes the only way to avoid chasing your tail when working on any circuit that contains service-defying feedback stages."

Most of the problems in switching supplies will be the same ones found in any other power supply—poor solder joints, broken wires, poor switch or variable control contacts, overheated parts, open or shorted components, or integrated circuits that are off-specification. Then there are the more esoteric problems! I ran into one recently myself, in a computer VGA color monitor using a switching power supply. It would change its width and brightness at times (because the regulated output voltage was changing), all by itself, and seemingly without any real reason, until I finally located the culprit. I was pretty well convinced that the controlled pass transistor package was the source of the problem, because tapping on it would often cause the fault to occur. I was ready to try hunting one down when I became suspicious of something else that the manufacturer had used in this particular monitor—a cream-colored adhesive that was used to hold some of the heavier parts down on the top of the printed circuit board. A couple of years back, I'd experienced similar adhesives becoming partially conductive as they aged, particularly when they became very brittle, as the adhesive on this board had. Furthermore, the way that the adhesive had been applied, a potential short circuit track existed between the line voltage bridge rectifier and the circuit common point, if in fact the adhesive itself had become partly conductive. Just on that bet, I removed (more correctly, chipped off) the adhesive in that area that would have completed a short, and as suspected, no more voltage variation. I removed the remainder of the adhesive in other locations just as a precaution, which only serves to illustrate that power supply problems come in many sizes and colors—just as in any other circuit! It's impossible to list all of the potential variations, but knowing how something is *supposed* to work, and playing a few hunches, can often pay dividends.

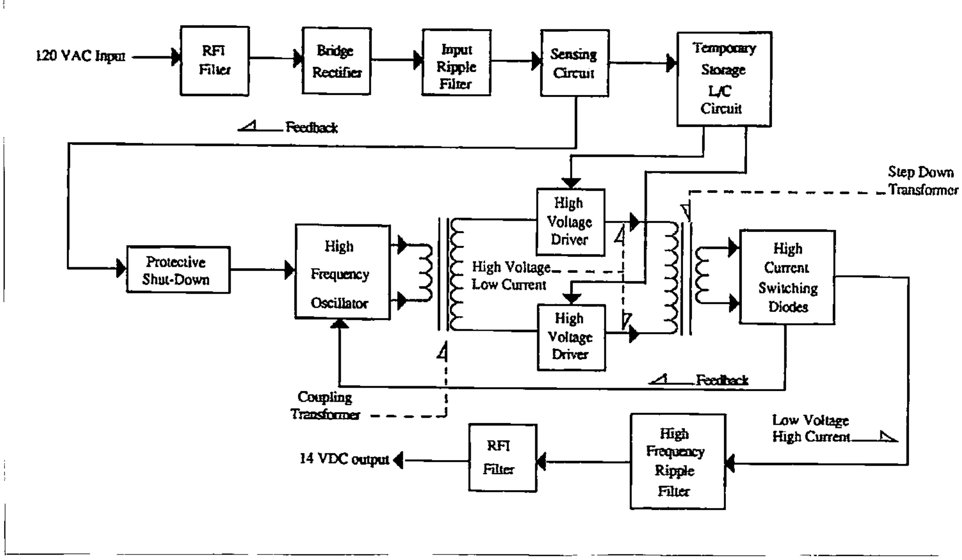

Fig. 5. One variation on a high current, low voltage high-frequency switching power supply from a recognized name-brand amateur radio equipment manufacturer.

Designing RF Probes

A simple one-hour test equipment project.

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An RF probe is used to directly measure the level of RF voltage present at a particular point. It is normally used with a digital multimeter (DMM) to indicate the voltage level as a DC voltage which is equivalent to the RMS value of the RF being sampled.

However, the level of RF being measured provides useful information only when the probe has been designed for use with a specific meter. The design of our RF probe is a function of the DC input resistance of the meter we intend to use with it. It can provide accurate information when used with a different meter that has the *same* DC input resistance, but will be inaccurate if the input resistance of the new meter differs from that for which the probe was designed.

Our probe design is somewhat unusual because we want to know the RMS value of the RF voltage we measure, and the probe actually detects and rectifies the peak RF voltage. Thus, it will be necessary to reduce the rectified DC derived from the peak voltage to a level equivalent to the RMS value of the RF at the probe tip. It is impossible to measure RMS voltage directly, except with a wide bandwidth oscilloscope. Therefore, we must design the probe circuit to do this for us.

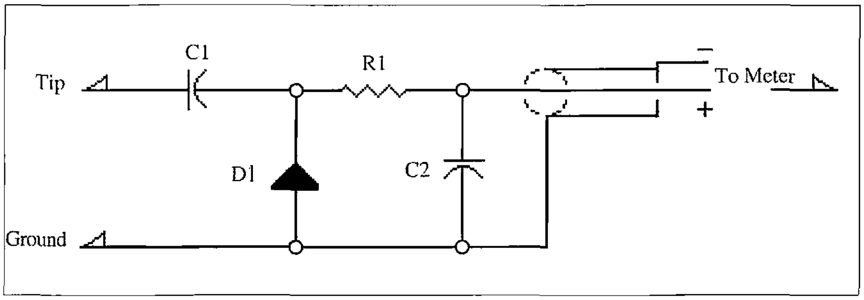

***Fig. 1.** It doesn't get much simpler than this.*

The circuit

Fortunately, this is simple. All we need to know is the DC input resistance of the specific meter. We'll use a commonly available full-function DMM which, in this example, has an input resistance of 10 megohms.

Fig. 1 shows the circuit of a common RF probe, easy to make and use. It's also very easy to design so it will be accurate. Cl and C2 are usually 0.01 µF monolithic or ceramic disc capacitors. Cl acts as a DC blocking capacitor to prevent any DC voltage at the tip from entering the probe. C2 is a filter capacitor to smooth any variations in the DC voltage rectified by Dl, normally a germanium diode.

"Can your analog meter be used instead?"

The rectified DC voltage at the cathode of D1 is at about the peak level of the RF voltage at the tip. Resistor Rl must have a value which will reduce this peak value to the desired RMS level. Because the peak voltage of a sine wave is 1.414 times the RMS value, Rl has to drop this excess voltage so the meter indication will be accurate. Because we know the meter has an input resistance of 10 megohms, we can calculate the value of Rl as follows:

$$10{,}000{,}000 \times 1.414 = 14{,}140{,}000$$
$$14{,}400{,}000 - 10{,}000{,}000 = 4{,}140{,}000 \text{ ohms (4.14 megohms)}$$

Rl should be 4.14 megohms (for use *only* with a DMM which has a 10 megohm input resistance).

This calculated 4.14 megs value is not a standard value, so we'll have to use two or three 1/4W resistors in series to make up the required value. We can either measure individual resistors from our stock of parts to come as close as we can, or we can do it the easy way by choosing 5% resistors and adding their value to come close to the desired value. For instance, a 2 megohm resistor and a 2.2 megohm resistor in series will produce 4.2 megohms, ±5%. Since this combination is only 60,000 ohms higher than needed, it is such a tiny percentage of over 4 megohms that it can be ignored. Electronics is a world of tolerances and percentages; as long as we come close to the value we need, it will work just fine.

Analog meters?

Can your analog meter be used instead? Sure, but you have to know the input resistance of the analog multimeter on the DC range setting you're going to use with your RF probe. For instance, there are FET multimeters available, most of which have a constant DC input resistance of 100k on all ranges, but this is the *only* type multimeter for which this

statement is correct. For this meter, Rl will have a calculated value of 41,400 ohms.

For other analog multimeters the input resistance will be different for each range. These meters are specified to have an input resistance of "X" ohms per volt. This value will be listed in the operator's manual or leaflet which is supplied with the meter or, in some cases, will be marked on the meter face.

Voltage

After you have determined the ohms-per-volt rating of your meter, you choose the specific voltage range with which you will use your RF probe. The full-scale voltage of this range will be used to calculate the value of Rl in **Fig. 1**.

As an example, consider a typical 20k ohms-per-volt multimeter, of which there have been more produced than probably any other except for the pocket-size 1k ohms-per-volt multimeters. We will calculate for both a 30-volt and a 50-volt range because these meters vary among manufacturers. You probably will have one or the other on your meter.

20,000 x 30 = 600,000 ohms input resistance
600,000 x 1.414 = 848,400
848,400 - 600,000 = 248,400 ohms (Rl)

20,000 x 50 = 1,000,000 ohms input resistance
1,000,000 x 1.414 = 1,414,000
1,414,400 - 1,000,000 = 414,000 ohms (R1)

Since we don't want to chance burning out Dl in our probe, we don't want to exceed the maximum allowable peak inverse voltage (PIV) that it can withstand. For the lN34 and lN34A the PIV is 60 volts. The lN270 will take 80 volts, the 1N191 will handle 90 volts, and the lN67A tops out with 100 PIV rating.

You may want to measure the RF voltage across a 50 ohm dummy load so the actual RF output power can be calculated. The peak RF voltage across 50 ohms will be from 10 volts at 1 watt to over 387 peak volts at 1,500 watts. A 100 watt transmitter will produce 100 peak volts across 50 ohms, so if Dl is a lN67A this would be an invitation for Murphy's Law to take effect. A 50 watt transmitter will produce more than 70 peak volts across 50 ohms, so we must be careful where we use the probe. It's a lot easier to build one than to fix it later.

It is possible to connect two or more of the same type diodes in series to replace D1 and increase the PIV rating of the probe. However, this practice will add stray reactance to the probe and affect its accuracy.

Although our RF probe is handy when working with transmitter powers of no more than about 30 watts, it is most useful when adjusting the RF voltages produced by VFOs, the local oscillator output to mixers in both transmitters and receivers, and intermediate stages and

"If D1 is an IN67A, it's an invitation for Murphy's Law to take effect."

some driver stages in transmitters. Power levels as low as 50 milliwatts will be easily detectable with our probe.

Construction

Now we need a probe body to put the circuit in, and we will need a metal tip. When the few components have been soldered together with very short leads, using a heat sink to protect the diode from the heat of soldering, we will need a shielded wire to connect the probe to the meter, and a red and a black plug to connect the shielded wire to the meter sockets. We will also need a ground lead and clip for the probe.

Depending upon the physical size of the component parts, especially Cl and C2, we can take apart a cheap office-type ball-point pen or a felt-tip pen for the probe body. RG-174 miniature coax, or even RG-58, can be used for the shielded wire. A small nail soldered to the lead of Cl makes a nice tip. A short length of insulated stranded wire and an alligator clip make a good probe ground.

For hams using low power—30 watts output or less—this probe plus Ohm's Law will allow the accurate measurement of RF power developed across a 50 ohm dummy load. The RMS voltage measured with the RF probe divided by the 50 ohm resistance of the dummy load will determine the RF current. Multiply the RF current in amperes by the RMS voltage to determine the power output in watts.

Parts List

C1, C2	0.01µF ceramic disc capacitor
D1	Germanium diode (see text)
R1	To be calculated (see text)

NEVER SAY DIE

Continued from page 9

century, brought over by English whites, who mainly settled in the South. The blacks are carrying on a heritage from their slave ancestors imported from England, not Africa. The development of public education in England eventually replaced this argot with standard English. Now it lives on in the American black culture, separating those who speak it from much hope of success in dealing with whites, or in getting well-paying jobs. It's one way blacks make sure that other blacks will provide a permanent black underclass.

Big Bummer

Yes, I've been on your case, trying to get you to stop sitting there like a lump in a bog and to stick a test prod into that jumble of gray goo in your head to jump-start some action. Our hobby is broke and needs fixing. Heck, it needs reinventing.

Sure, I keep coming up with ideas, but instead of generating your own in response, what I'm getting most of is apathy, with a secondary pile of kvetching. Yes, I'm complaining, but I'm not surprised or upset. After all, this is the same reaction I'm seeing to the call for ideas on how to solve our major social problems ... like welfare, the deficit, crime, the so-called drug war, and so on.

Heck, you're not even particularly upset over how much you're paying in taxes, which on the average these days is taking all of your wife's pay. And this is despite endless TV exposés showing you how your money is being wasted on crop supports to rich farmers (even tobacco supports!), rip-offs of virtually every federal bureau by crooks, enormous stockpiles of useless military supplies, and so on. There are a whole bunch of books exposing this stuff, showing where hundreds of billions are being wasted. Ho hum, right?

Getting back to amateur radio, I made a suggestion for a new approach to the hobby several years ago which just came back to

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A Low Current Light

Great for portable operation.

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Portable operation at night on camping trips poses a problem. Even the lowest current incandescent bulb eats a lot of power, so when your station is powered by a small gel cell battery, as are most portable QRP stations, every milliampere that can be saved for communications is precious. Also, the usual white light from a flashlight or even a pilot lamp is a magnet for every nearby flying insect.

There are "giant" LEDs 10 cm in diameter in clear plastic which produce a bright red light. They require 1.8 VDC at 20 mA. These are produced as replacements, several in a cluster, for automotive taillights and brake lights. I don't know of any source for these; I found one surplus several years ago and tried it out—I found that red light is no good for reading dials, meters, and switch positions. It also attracts its share of insects.

The best choice is yellow light. Unfortunately, most yellow LEDs produce very little light, and also require a dropping resistor which wastes precious milliamperes in heat. Much better are the T1-3/4 yellow LEDs (Mouser 509-HPY5066X). Nine of these 1.5V in series across a 12V battery draw only 17 mA, with no dropping resistor needed. And, because the LEDs have an expected life of 50,000 hours, they won't burn out just when you need them most.

Although using eight LEDs would seem to make more sense in a 12-volt system, the ninth LED helps to prevent excess current when a gel cell battery has been freshly charged and its terminal voltage exceeds 12 volts. It also allows the nine LEDs to be mounted in a 3 x 3 arrangement to concentrate the light.

> ***"Because these yellow LEDs have an expected life of 50,000 hours, they won't burn out just when you need them most."***

Construction

The LEDs should be mounted as close together as possible to better concentrate the light. Be sure to observe the correct polarity of each LED. The longer lead is the anode. While reverse polarity won't harm the LEDs, no light will be produced.

Although this is not the brightest light in the world, it will attract very few insects and the light produced is quite adequate for operating your rig and keeping a log. 73

Can You Top This?

The world's tallest mobile antenna?

Jim Ford N6JF
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Costa Mesa CA 92626

If you've ever driven on Pacific Coast Highway in Huntington Beach, CA, or been at Southern California's TRW Ham Swapmeet, you've probably seen what is most likely the world's tallest mobile antenna. These have frequently been spots for Don Daily AA6GE to set it up.

It's mounted on top of his 1976 Ford van and can support many antennas, going from about 11 to 160 feet! Impossible, you say? Well, I thought so until I saw it.

You say, "This surely must be guyed." Well, it is, sometimes. At 160 feet the antenna is far from straight unless it is guyed, but he has driven around with it at 160 feet (1 mph?). Don, licensed since the mid '50s, and familiar for many years as WA6EKD, is no stranger to big projects. From Riverside (CA), in 1969 through 1971 he had an eight-element 105-foot boom 20 meter yagi on his homemade self-supporting 130-foot tower. It was secured with 20 tons of concrete! By profession, Don is a plant maintenance engineer and his knowledge of machine shop tools, processes, and materials is evident in all of his projects.

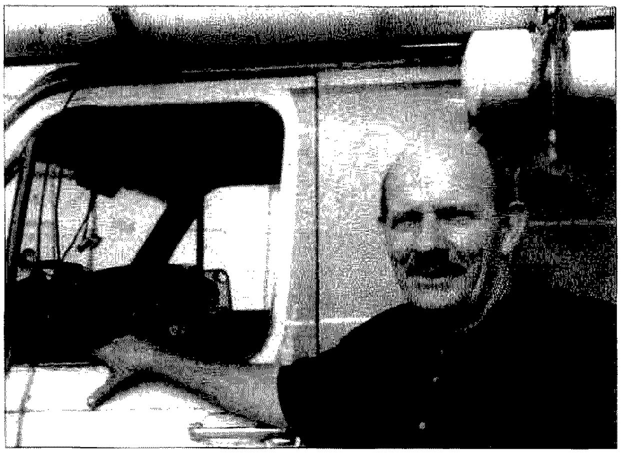
Photo A. Don Daily AA6GE.

The details

The bottom of his Space Needle, as he calls it, is made from 6.5 inches of 1/2" wall-thickness 7075 T6 aluminum. The remaining tubing is made from 6061 T6 aluminum, with the 120-foot level having a 2.5" OD. This was the level at picture time, with a rotator and small horizontal 2 meter beam at that point.

"It was secured with 20 tons of concrete!"

When in use as an antenna and not as a tower, it tapers to 3/4 of an inch at 150 feet. A CB-type whip adds an extra 10 feet, for a total of 160 feet. The pole is insulated from the van with four 1' x 1' x 1-1/4" phenolic blocks so it can be used as an antenna or tower. The total weight of all his antenna poles, which are stored in large-diameter white PVC tubes, is 800-900 pounds. The bottom section is guyed to his van with 1/2" braid, which is the type of line used on yachts and has a test strength of 18,000 pounds. The gin pole used for raising the antenna uses XLS 900 5/8" braid line rated at 27,000 pounds.

Don's experiences

Don doesn't always put up the 160-foot monster, but he frequently has antennas over 100 feet. Often, the only guys used are those that are attached to his van. He has mounted four 19-element 2 meter antennas on his Space Needle at 80 feet! He has setup time down to 45 minutes, and claims that there haven't been any scary wind episodes. He has operated a 70-foot antenna in 40 mph winds. Ham operation on 160 meters is difficult for many of us because of the large antenna length required, but Don likes the 160 band since he can put up a full-size 1/4 vertical!

When asked if he would rather have a motor home or house trailer, Don says no. He thinks a trailer or motor home might not be strong enough for his purposes, and besides, they would have a difficult time getting to some of the places where he likes to operate. He likes to operate as near the ocean as he can, to get the benefit of an ocean ground, or from mountain peaks for the quiet location and terrain enhancements. In his experience, a good HF mountaintop location is one which drops off rapidly.

To say he gets good signal reports from his van is an understatement, but the good reports are due in part to his ability to pick good locations. I visited

him one time when he was at a location near the top of Modjeska Peak in Orange County, CA. And I do mean the top because he definitely needed the winch mounted on the front of the van to get up the last 50 yards.

Don is planning a replacement for his aging '76 Ford van, but with all the customization and airbag suspension on his present van it may take a while to bring it up to his standards. Big-time mobile is not new to Don. He has used this van with somewhat smaller antennas for the 15 years I have known him. And yes, if you wondered, Don has been single since two years before the van.

Fully loaded, the van weighs as much as 10,300 pounds, but it was only 9,500 pounds at the time these pictures were taken. He is equipped with 10 100-pound batteries! This allows three- or four-day desert and mountain radio DX trips. He has worked over 250 countries and most of the US counties in this van.

Don is usually equipped for operation on 160 meters to 1296 MHz, but recently sold some of his less-used VHF and UHF gear and used the money for some of his other hobbies. He bought a trailer and mini 4WD military surplus vehicle called "The Mule" about a year ago and uses them for gold mining and astronomy trips. This allows him to carry two 650 watt generators, one 1 kW, and one 3.5 kW. The 3.5 kW generator is needed when he wants to use his kW HF amplifier, consisting of a pair of 3-500Z tubes. He also has solid-state amplifiers for VHF, and one for HF for battery operation when not running the tube amp. His well-secured van is a ham contest station on wheels.

***Photo B.** Looking up at 120 feet.*

I've seen this and many other of Don's antenna projects evolve over the last 15 years, but I am still amazed. Safely completing a project like this is not for many of us. Don would like to claim the world's highest mobile antenna. If you see AA6GE going down the road, give him a Morse code HI beep on the horn.

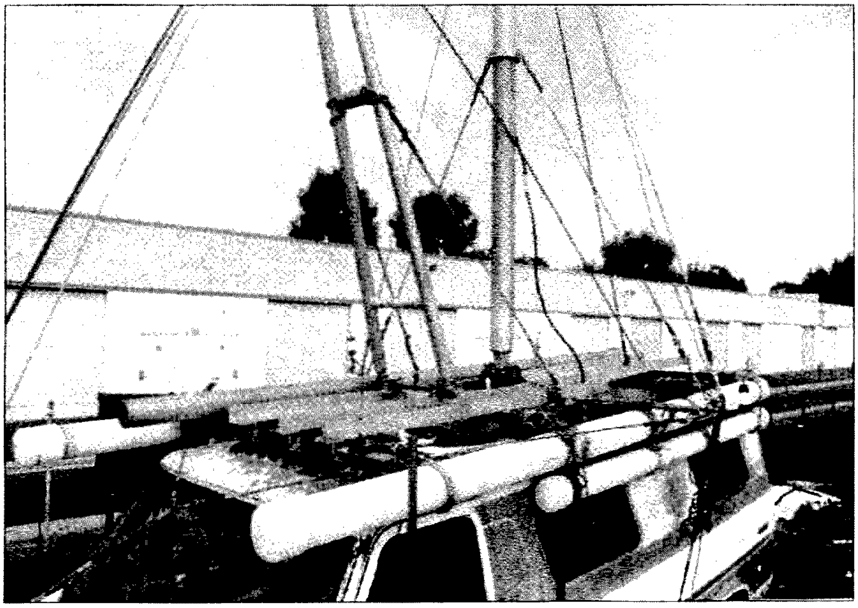

***Photo C.** Roof view. Do you think Don has ever been on a sailboat?*

The 48-46 Antenna

The CCD antenna is now available for the amateur bands.

Harry Longerich W4ANL
Rte 1, CV 9
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What is the 48-46 antenna? It consists of 48 pieces of wire interconnected with 46 capacitors. The technical name is "Controlled Current Distribution" antenna, or CCD. It's been around for a long time in the commercial broadcast field, and recently it was configured for use on the amateur bands. An excellent description and analysis of the CCD antenna is available in both References 1 and 2; these are worthwhile reading.

Rather than making a dipole out of two continuous lengths of wire, the CCD antenna uses capacitors to vary the phasing of the currents in the antenna to ensure that the most possible current is distributed to all sections of the antenna. These capacitors are inserted in series with the elements, about one every yard, for the complete length of each dipole element. In the 48-46 antenna each side of the dipole is made up of 23 capacitors and 24 sections of wire, each 35 inches long. The dipole is center-fed with open wire line via a transmatch. The 48-46 antenna uses a new approach to mounting the capacitors, and I also give some hints on how to build a simple RF detector to make sure the antenna currents are properly distributed.

Why consider a CCD antenna? Well, it has several distinct advantages over the conventional dipole:

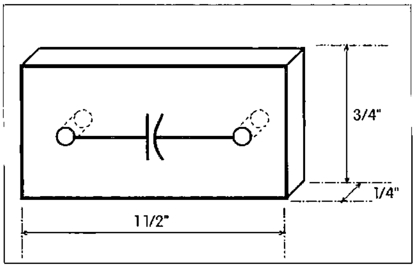


Fig. 1. Lucite or Lexan insulator with capacitor.

(1) It has about 3 to 4 dB gain over a conventional dipole at the basic design frequency.

(2) There are minimal high voltage loops on the antenna.

(3) There are no end effects of any consequence.

(4) The antenna may be erected in any manner, shape, or form—whatever suits your real estate.

(5) The entire antenna radiates. A dipole has about 67% radiation efficiency. The CCD approaches 97%.

(6) The CCD antenna, when used with an antenna system tuner, will have a gain on the fundamental design frequency and will operate on all higher amateur bands. It will not work properly on frequencies lower than the design frequency.

(7) The CCD antenna may be erected close to the ground without seriously affecting the efficiency of the radiated signal.

(8) This antenna is very quiet when used in the receive mode.

(9) Construction is straightforward (though time-consuming—96 solder connections are involved in building this type of antenna).

(10) The feed-point impedance will vary between 275 and 325 ohms, and will require the use of a balanced line or a 6:1 balun when used with a coaxial feedline.

Construction details

Initially, I built a 7 MHz CCD antenna. Though it is not difficult, construction does take some time. I started by cutting 48 pieces of wire, 35 inches long, with a 1-1/2-inch pigtail at each end, making each piece a total of 38 inches overall. I used Teflon™-covered wire, 16-gauge stranded. I used covered wire because here in Texas we have occasional severe weather, and precipitation static can be a problem. The covered wire reduces this type of static. Because there are no high voltage loops on the antenna, using covered wire does not cause undue losses.

In order to simplify measuring the wire to 35 inches, I built a simple jig on a piece of 1-inch by 2-inch wood, drove in two nails, 35 inches apart, and bent the wire at the 35-inch dimension. I judged the 1-1/2-inch pigtails. After cutting and stripping the 48 lengths of wire, I cut 49 pieces of Lucite™ (you can use Lexan™ if it's available) and drilled them as shown in **Fig. 1**. The Lucite insulator provides a means to connect adjacent wire elements as well as a way to mount the series capacitors.

"When conditions are right, I can copy European stations 5 x 9 plus on 75 meters."

When mounting the capacitor, it is important to provide sufficient capacitor lead slack to relieve stress on it. Obtaining the capacitors shouldn't be a problem. I bought 60 390 pF silver micas rated at 200 volts, with a tolerance of 5%. They cost nine cents each at a surplus outlet. The 200-volt rating will safely handle the legal amateur power level. One reason for buying 60 capacitors was to insure that I would have 46 capacitors that were within the 5% tolerance rating. Nine capacitors did not meet the requirements. Using polyester capacitors is better, but they are more

expensive. If possible, buy capacitors with long leads; it simplifies connecting them to the wire elements. Once the capacitors were mounted and connected to the wire elements, I covered them and the leads with RTV compound. This provides an excellent weather seal.

Check the current flow

Before you erect the antenna in its final location, install it about four feet above the ground. Remember, it does not have to be in a straight line; install it to suit your real estate. When you have erected the antenna at the four-foot level, use a simple RF sniffer (**Fig. 3**) and excite the antenna with 3-5 watts of power. Start at the feed point and work to either end of the antenna. At the feed point you will have some indication of current. It makes no difference what the reading is; whatever it is, use that as the reference reading. Work your way to the end of the antenna. As you approach a capacitor the reading will decrease a bit, but as you travel to the end of the wire element the reading should again increase. If a reading should drop off after moving away from the capacitor, you have a problem in that section. It could be a bad capacitor, broken lead, or poor solder connection. Correct this before proceeding further with the measurements. Remember: When making these measurements, do not change the power output of the exciter.

Installation

Once you have ascertained that the current flow is uniform throughout the entire length of the antenna, you are ready to install it on your real estate. The length of the feedline is immaterial but, of course, the shorter the better. The lowest point of my 3.5 MHz antenna is four feet high. The center of the antenna is about 35 feet, and it is mounted among 40-foot trees, through branches and close to buildings. When conditions are right, I can copy European stations 5 x 9 plus on 75 meters. The 7 MHz antenna is also among trees, and I can work VKs, 5 x 8 – 9, using 100 watts when propagation conditions warrant.

This is exciting

One of the problems of living in Central Texas is that ground conductivity is very poor. To overcome this, I installed a #16 copper wire, buried one inch in the ground, and followed the exact pattern of the erected antenna. Initially, when I excited the antenna with 5 watts, the RF sniffer indicated a reading of 29 microamperes. With the ground wire in place and 5 watts of excitation, the RF sniffer indicated 33 microamperes at the ends of the antenna. What this told me was that the antenna was passing more current, and the radiating efficiency had increased. Reference 2 states that the use of capacity-loading disc screens at the ends of the antenna will increase the radiation resistance, improve current distribution, and almost completely eliminate end effect. The end caps I use are illustrated in **Fig. 2**, and they are mounted vertically, about three feet above the ground wire. The resonant frequency of the antenna was lower, so I eliminated one section from each end and the frequency was about 6.995 MHz. I again excited the antenna with 5 watts and

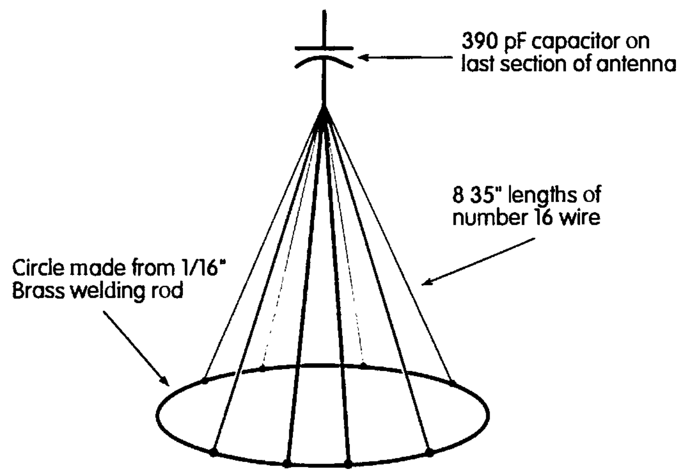


Fig. 2. End capacity hat for 7 MHz CCD antenna; two required.

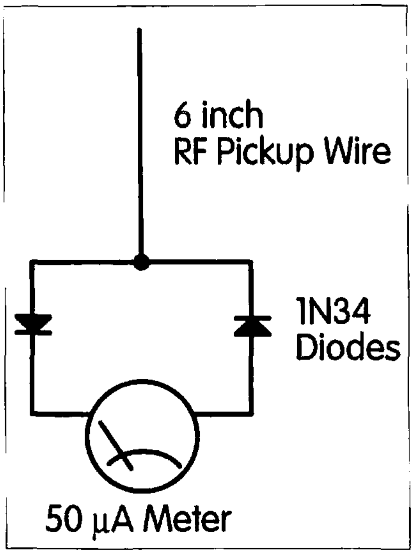


Fig. 3. RF sniffer (will operate up to 100 MHz).

the reading at the end cap was 41 microamperes, an increase of 8 microamperes—another substantial gain increase.

A word about feeding the antenna: If you plan to use coaxial cable, I suggest you use a 6:1 current balun mounted at the feed point of the antenna. The use of an antenna system tuner is a definite plus when using coaxial cable. I personally prefer using a balanced line. A good-grade 300-ohm TV twin lead will work well with powers up to 500 watts. A 450-ohm balanced line will also work. A tuner must be used with both of these lines.

Frequency check

Before you erect the antenna you may want to try to check the resonant frequency with a grid-dip meter. You'll be in for a surprise. My 7 MHz antenna resonates at 6.995 MHz, which is about normal for this type of antenna. You may, if you desire, cut off one or two sections from each end of the antenna to bring it into the 7 MHz range. I tried it, but it made no difference in the current readings or performance of the antenna. Remember: When grid-dipping an antenna, always make the measurements at the feed point of the antenna.

Try this tuner

A word about antenna system tuners: I built AG6K's Balanced Balanced Tuner[3] and it is a beauty. This tuner uses a balanced input system, which really makes good sense. I used a 1:1 current balun made with ferrite cores. The output of this tuner is balanced, no balun is required, and the efficiency is excellent. With my 7 MHz CCD antenna, I was able to obtain a 1:5:1 SWR from 7 MHz to 29.99 MHz. For those of you who like to experiment, I recommend trying this tuner. I have also used a conventional LC network tuner which worked very well, but it was a bit cumbersome when switching to bands other than 7 MHz. Any good grade of commercial tuner may also be used with good results.

Designer's choice

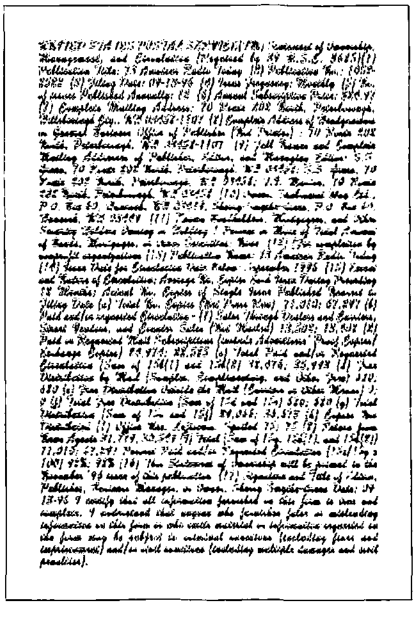
This antenna may be erected in any configuration that suits your real estate. I have erected them as inverted Vs, bi-square, and even lying on the ground. Rest assured, they will perform. My present goal now is to cut down some trees (when the XYL isn't looking) and try two 7 MHz CCDs, spaced about 18 feet apart, and reverse the feeds for east or west directivity. If anyone has had the opportunity to try this, or has any input on the CCD antenna, please let me know the results. 73

References:

1. Harry A. Mills, Gene Brizendine, "Antenna Design: Something New," *73 Amateur Radio Today*, October 1978.

2. Harry A. Mills, Gene Brizendine, "The CCD Antenna - Another Look," *73 Amateur Radio Today*, July, 1981.

3. Richard L. Measures AG6K, "A Balanced Balanced Antenna Tuner," *QST*, February 1990.



Number 25 on your Feedback card

Hamtronics R139 Weather Satellite Receiver

Enjoy monitoring atmospheric conditions and the satisfaction of building the kit!

Larry R. Antonuk WB9RRT
P.O. Box 452
Marlborough NH 03455

I'm not really sure *why* I got interested in satellite weather reception, but I remember exactly *when*. A member of the local radio club was putting on a demonstration at a club meeting. He had assembled a very simple interface, using perhaps a single chip and a cap or two built into a 25-pin D-sub connector hood. One end of this hooked to his receiver, the other end to his computer. Using a piece of demodulator software he obtained from the Internet (as freeware, no less), he was able to decode HF weather facsimile pictures—quite respectable pictures, too, except that most of them were of very interesting cloud formations out over unrecognizable areas of the ocean someplace. As my interest grew over the next few weeks, I found that most of these HF transmissions are intended for ships at sea. This meant that my chances of receiving highly detailed photos of the weather surrounding my home QTH in the hills of New Hampshire were pretty slim. However, while doing research on weather transmissions in general I found out about something even better than the HF transmissions. It was apparently possible to receive the broadcasts from the satellites themselves—in real time—as they were going overhead. This made much more sense than worrying about trying to capture some out-of-date military transmission on the HF bands. At the time I realized that this project would be a little more complicated than mounting an IC inside a DB-25 hood, but I decided to go ahead with it.

My research took me through several magazines, a few books, and one highly recommended manual (*The ARRL Weather Satellite Handbook*). I found that the satellites I wanted to receive all worked in the 137 MHz band. These were the American (NOAA), Chinese (Feng Yun), and Russian (METEOR) birds. The NOAA satellites were more "available"—that is, they passed overhead more often, and more of them were still transmitting useful data. In addition, the NOAA birds transmitted both visual and infrared images as they circled the earth. These satellites circle the earth in near-polar orbits, meaning that from a given location, each of them may be in range several times a day. In any case, there were three main components needed in any decent station capable of receiving the polar orbiting automatic picture transmission (APT) satellites—a receiver, a demodulator, and an antenna system. I felt that my first step should be the receiver. Once I had that built and could determine whether or not I could actually hear any satellites, well, then I could decide if I wanted to actually spend some money to find out what the pictures looked like.

"It's possible to receive the broadcasts from the satellites themselves—in real time—as they go overhead."

According to my sources, there were two main choices for the 137 MHz receiver. The first was an actual 137 MHz radio designed for satellite reception. The second was to use a modified scanner. The reason that an off-the-shelf scanner needed to be modified had to do with the bandwidth of the APT signal. The weather satellites transmit a signal modulated with a 2400 Hz tone, at ± 15 kHz deviation. This is three times the level used in most normal communications gear. While it would be possible to receive these signals on a normal receiver, much distortion would result due to the lack of modulation acceptance, and the results would be unsatisfactory. I found it was possible to modify a scanner to eliminate the IF selectivity, which would allow the wider signals to pass through. Unfortunately, this would allow unwanted signals to pass through as well. Since I lived near an airport I was already worried about the effect of the nearby aircraft band transmissions. I decided that a widened IF, coupled with the wide front end of the scanner, would be more trouble than it was worth. I decided to shell out the bucks for a real receiver.

Photo A. The completed R139 Weather Fax Receiver.

After reviewing the options, I chose the R139 Receiver from Hamtronics, Inc. The R139 represented a good compromise between cost, performance, and bells and whistles. The R139 comes as a five-channel crystal-controlled unit, with scanning capability. It has a 0.2 μV sensitivity, due to its low noise dual-gate FET RF amp circuitry. Modulation acceptance is 38 kHz, meaning it's designed just for the bandwidth of the polar orbiters. A tunable front end is

used to provide plenty of rejection to off-channel signals. The R139 also has separate outputs for speaker audio, demod output, and a special line to control a tape recorder. I found that I could save quite a few dollars by building it myself, so I ordered the kit.

Assembly of the main board took a couple of leisurely evenings, and I finished up the alignment and cabinet installation on a Saturday morning. As is usual for Hamtronics, the board and components were of very high quality. Documentation was not a step-by-step installation procedure—the builder is given some credit (and responsibility) for knowing what he or she is doing. The assembly instructions consist of about a dozen paragraphs, giving hints and pointers about each group of parts. More specifics are given about the size of parts to install at a given time than about which part goes where: "After a group of shorter parts like these are installed, you can put in taller parts like L3 and L2." This prevents the assembler from making any moves that will make life difficult later, while still giving him the responsibility to choose the order of assembly.

Once the assembly is complete, it's time for alignment. Note that you do indeed need a signal generator for this procedure (a friend with a signal generator works just as well). The documentation does provide step-by-step information on the alignment of the receiver, as well as several hints and suggestions as you go along. (Note that the slug-tuned coils require the use of a .062" square tuning tool. If you don't have one, make sure to order one along with the R139. They're cheap compared with the suffering experienced when you break a coil slug on Saturday night because you tried to use the wrong tool, and you can't get a new slug until Monday, and you'll never know all weekend if your receiver is working or not. Not that the author has ever had this experience...)

Once the unit is aligned, it's time to hook it up to the demodulator and the antenna. Connections are easily made through a 9-pin D-sub connector on the rear panel. My first attempt was simply to set the squelch and turn up the volume as I went about my business in the house. Within an hour I was hearing a reassuring "tick-tock" coming from the speaker, using just a VHF discone antenna. I hooked the demod output to a tape recorder, and connected the TAPE CONTROL output of the R139 to the REM IN of my tape recorder. Nothing happened. I figured that the open collector output in the R139 couldn't sink enough current to start the motor on my 1970s vintage tape recorder, so I added a small relay to do the job, which corrected the problem. (I later found that this was carefully explained in the part of the instructions I hadn't bothered to read, but that didn't diminish my feeling of accomplishment at having engineered the solution myself.) I started recording passes, and worked on figuring out how to get my demodulator to work.

The first several images I demodulated were confusing—nice cloud formations, some land masses—but I couldn't for the life of me figure out where they were being taken. I had no idea of the scale; was that chunk of land a peninsula on Cape Cod, or was it Florida, or maybe the tip of South America? Not only that, but since some passes are received going north to south, and some south to north, the upside-down land masses can be very difficult to recognize. (This inverted orientation can be corrected with the viewing software.) Finally, on a Saturday morning I heard a pass going over. I came into the shack and found that I was out of tape in the tape recorder, so I demodulated the image directly from the R139. As the picture crept down the screen, line by line, I could make out some clouds, then a big lake, then some more lakes, then—Hey! The Great Lakes! Nine-Land! My old stomping grounds! There were a few clouds over Minnesota and Lake Superior, but northern Wisconsin was as clear as a bell. Elated, I immediately called my parents (Harry and Jean) back in Wisconsin and informed them that I could tell they had clear weather at their house. They were quite unimpressed, even when I explained the amazing advances in technology that allowed me to tell them this. When you've lived from telegraphs to cell phones, and from crystal radios to CNN, I guess it's hard to be excited about a simple satellite receiver. But I sure was!

"A great way to get into satellite weather reception."

As the weeks passed, I collected more and more images, some impressive, some not so exciting. The R139 dutifully turned on the tape recorder and recorded each pass, whether it was going directly overhead or photographing someplace I wasn't interested in. In addition to these unwanted passes I found that I wasn't getting as large or as clear a picture as I should have. My simple discone antenna wasn't up to the task of pulling in enough signal for quality satellite photos; I obviously had to fine-tune the system. First, I needed to find out how to use my demodulator and software more effectively so I could choose the satellite and pass I was interested in. Second, I needed to upgrade my antenna system to something more appropriate to the demands of extra-terrestrial transmissions. But in the meantime, my Hamtronics R139 Weather Fax Receiver was pulling in the pictures, and I was busy printing out images to impress the guys at work.

All in all, the Hamtronics R139 Receiver is a great way to get into satellite weather reception. Although not a kit for the first-time builder, if you've got a project or two under your belt and have access to a signal generator for the alignment, the R139 is a top-notch receiver for the money. For more details contact: Hamtronics, Inc., 65 Moul Road, Hilton NY 14468-9535 or call: (715) 392-9430.

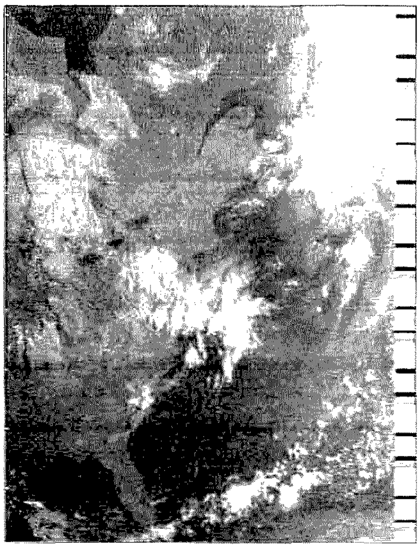


***Photo B**. A sunny day in New Hampshire. This infrared image stretches from the tip of Florida all the way north to the bottom of Hudson Bay. The bars on the right border are the synchronization signals that are transmitted at the beginning of each line.*

NEVER SAY DIE

Continued from page 18

mind. When I wrote a set of rules and regulations for Jordan back in 1970 I proposed something along this line, with the call prefixes reflecting the progress a Jordanian amateur had made.

The recent Boy Scout Jamboree On The Air (JOTA) reminded me of my idea of setting up a similar merit badge system for hams. We could have one for working all states on any particular band and mode. Another for working 100 countries on a band and mode. 20m-SSB, for instance. 40m-RTTY. 160m-CW. With badges for packet, slow-scan, satellites, and so on. If we want more CW activity, why not offer a badge and certificate for using CW to work and states and 100 countries? Ditto packet, and so on.

With a set of goals like that we wouldn't need six different license classes.

If You're So Smart ...

Okay, as a ham you are a communications expert. Well, you're supposed to be. That's what you've conned your non-ham friends and the FCC into thinking, right?

So what do you really know about communications, other than kerchunking some repeaters or adding still more garble to a pileup? If someone were to ask you about pagers, what could you tell them? How much do they cost? What's their range? Where do you get 'em? What frequencies do they use? What services are available? Can you use them around your own business?

And what can you tell people about fax-modems? The Internet, CompuServe, Prodigy, bulletin board systems, and so on?

There are almost endless communications services out there. Now, if you, as a bona fide federally licensed communications expert, can't answer even simple questions about 'em, imagine how confused the average business person is when faced with choices of telephone switches, cellular telephones, teleconferencing, security systems, computer networking, and so on. All this is so far beyond the average person to deal with that you have a tremendous opportunity to make some money ... once you know your stuff.

No, you don't know all the answers now, but with your ham background, at least you can understand the questions and you have some clues on where to find the answers. Knowledge is not only power these days, it's money. There are at least 10 million small businesses that could be benefited by better communications, security, and computer systems. That's one heck of a market.

How long do you think it would take you to become an expert on pagers, just to pick one field at random? You need to get literature from the manufacturers, dealers, and service companies. You'd want to read a couple books on the subject. Are we talking six months? One month? A week?

Next you'd want to visit some of the companies involved in the business and talk with them. Find out their problems, what success stories they have, which equipment they think works best, and so on. Couple months in your spare time?

Now that you have a good understanding of the technology and the players, and have the contacts you need, what should you do next? My recommendation would be to sit down at your computer and write a brief handbook on the subject ... maybe 32 pages. Write it for the nontechnical average business person. Explain the benefits your service provides and show how the costs are small compared to the benefits. You can make the handbook look professional by printing it on a laser printer. The first hundred copies can be made on a copy machine. That's the way I do my booklets until the demand gets out of hand.

This will provide you with some sales literature for your new communications consulting service. With your name as the author, this certifies that you are an expert. Now you're in a position to send letters to local businesses offering the first phase of your communications consulting services.

Once you know your stuff on pagers it's time to pick the next business you're going to learn. If you've made any efforts toward selling your pager expertise, by now you'll know what questions business people are asking about other communications services. You might tackle fax-modems next.

Same deal. Get the literature. Read the books. Talk with the manufacturers, dealers, and services. Help some friends for free, learning on their money. It's always best to use other people's money (OPM) as much as possible when you are learning.

Within a year, if you make any kind of an effort at all, you'll be Mr. Communications in your town, and you'll have dozens of small businesses turning to you for solutions. In the communications business you make money on sales, on installations, and on service. Great business. All communications equipment breaks, so the service business is wonderful. And computers, being the most complicated of all, break the most often. Plus there are viri, incompatible software, static electricity, errant magnets, and so on to help keep you living comfortably.

Oh yes, it won't hurt to become an expert on magnetic fields and go around with your gaussmeter and help people avoid possibly harmful fields. There are some inexpensive gaussmeters on the market that do a wonderful job.

And when your customers want to know whether cellular telephones are harmful or not, you'll know the answer and be able to give them a reprint of an article from *73* on the subject.

There's no reason for any ham with even the slightest amount of gumption not to be living in comfort and have as big a ham station and antenna farm as he (or she) wants.

Expert Help Needed

If you are already an expert on any phase of communications, how about writing an

Continued on page 33

A QRP SWR/Power Meter

Just by recalibrating the MFJ-860.

J. Frank Brumbaugh KB4ZGC
Box 30, c/o Defendini
Salinas PR 00751-0030

The MFJ-860 cross-needle SWR/PWR meter is a small 4-1/2" x 2-1/4" x 3" (WHD) lightweight instrument which provides simultaneous indications of SWR and forward and reflected RF power in two switch-selected ranges of 30 and 300 watts into a 50-ohm load. The meter face also includes a 0-to-6-watts scale which can be used for QRP operation after completing the modification in this article.

Only your QRP transmitter, a dummy load, and a small screwdriver are needed to do the job. After this modification there will be two ranges as before, but one will be 6 watts full-scale forward and the other will be 30 watts. No hole drilling or soldering will be necessary, unless you decide to add a switch and capacitor to provide a choice of average or peak output power.

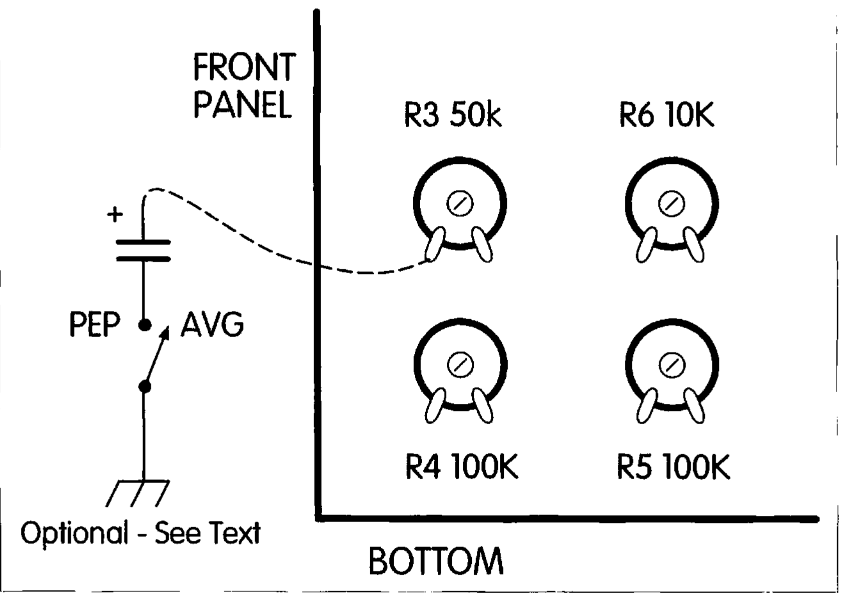


Fig. 1. Identification of calibration trimpots.

Calibration

Remove the two screws holding the clamshell case together and place the top aside. Turn the instrument with the right side facing you. You will see four black trimpots mounted at the upper left of the printed circuit board (**Fig. 1**). The upper row, from the panel side to the rear, control forward and reverse power levels on the current 30-watt range. This will be recalibrated to indicate 6 watts full-scale. The lower row of trimpots, from the panel side to the rear, control the forward and reverse power levels on the current 300-watt range. This range will be recalibrated to indicate 30 watts full-scale.

Because of the values of trimpots used by MFJ, recalibrating both ranges is easier than attempting to change the 300-watt range to indicate 6 watts full-scale.

Connect a 50-ohm dummy load to the antenna connector on the rear deck. Connect the output of your QRP transmitter to the transmitter connector on the rear deck. Put the range push-button switch on the panel to the 30-watt range. Turn on and key your QRP transmitter, setting it to any exact wattage between 1 and 6, but preferably 5 watts. **Note:** If you connect a coaxial tee to either connector on the rear you can use your RF probe and DMM to accurately set the RF power output. A reading of 15.81 volts indicates 5 watts into 50 ohms.

Assuming you have 5 watts of RF input, adjust R3 (50k) until the meter indicates 5 watts on the lower "Forward" scale on the meter face, midway between the numerals 4 and 6. This completes calibrating the 6-watt forward power range.

Now change the range switch on the panel to the 300-watt range. With the same 5 watts input, adjust R4 (100k) until the meter indicates 50 on the upper portion of the "Forward" scale. This point is 5 watts on the new 30-watt scale, and completes its calibration.

Now unkey your QRP transmitter and reverse the connections on the rear deck with the dummy load hooked up to the transmitter connector and your transmitter hooked up to the antenna connector.

Check that the range switch is still in the 300-watt position, key your transmitter to apply 5 watts in the reverse direction, and adjust R5 (100k) until the meter indicates 50 on the upper side of the reflected scale, then unkey your transmitter. This completes calibration for reflected power on the new 30-watt scale.

If you can reduce transmitter output power to 1 watt you can calibrate the reflected power range on the new 6-watt scale, as follows:

you can read SWR on either range. However, if you were unable to reduce power to 1 watt, and therefore could not calibrate the reverse range on the 6-watt forward range switch position, you won't be able to determine SWR on this range. In this case, tune up on the new 30-watt range where the SWR indication will be accurate.

"Only your QRP transmitter, a dummy load, and a small screwdriver are needed to do this job; no hole drilling or soldering are required."

Warning: Do not apply more than 1.2 watts in the reverse direction on the new 6-watt range—you can easily destroy the meter. Reduce power from your transmitter to 1 watt, a reading of 7.07 volts with the RF probe into 50 ohms. This should be indicated at 10 on the upper "Reflected" scale because the range switch is still set for 300 watts. Place the range switch in the 30-watt position (the new 6-watt range). Adjust R6 (10k) *very carefully* until the meter indicates 1 watt on the lower "Reflected" scale. This adjustment is touchy because 1 watt indicates with R6 very near the zero resistance end of its rotation. Unkey your transmitter. This completes recalibration of the MFJ-860. If desired, you may change the panel markings on the range switch from 30 to 6 watts, and 300 to 30 watts.

Adding Peak/Average Power Switching

Refer to **Fig. 1**. There is more than enough room on the panel, either between the meter and PC board or between the PC board and the right end of the panel, to mount a small toggle switch. The electrolytic capacitor (22 µF) is suggested, but you can use any size that provides the time constant you prefer when indicating peak power output. It can be tucked wherever it is convenient. Its voltage rating is unimportant because the leads carry only very few DC volts. With the toggle switch OFF, the meter will indicate average (rms) power. When the switch is ON, as when operating SSB, the meter will indicate peak RF power.

About SWR

The MFJ-860 meter is so calibrated that SWR is indicated on the red arc where the needles cross. The ideal situation is to show no reflected power, indicating an SWR of 1:1. If you were able to calibrate *both* reflected power ranges

Conclusion

Remember, when using the new 30-watt range, divide the power indication by 10 to determine your power output. For instance, 50 on the "Forward" scale indicates 5 watts output.

If you operate at or close to the 5-watt output level and use SSB, leave the meter set on the new 30-watt scale. The PEP of a nominal 5-watt SSB signal will peak at around 8 watts, which will be off-scale if you use the new 6-watt scale.

A Dirt-Cheap Broadband 80 Meter Vertical

The "outhouse" antenna.

Carroll R. Markivee WØRKU
71 Cedar Ridge
Eureka MO 63025

Efficiency is the hottest topic in antennas, according to articles I have read recently. In my book, the most efficient antenna is the one that puts out the most signal for the least money. That means using what you have or can get cheaply, both hardware and geography, to the best advantage. By my standards, one of the most efficient radiators is a length of wire and one of the most efficient supports is a tall tree or anything else that is high and dry.

The second most important topic is the SWR. Most 80m antennas have a low SWR over only two or three hundred kHz of the band. You have to choose the low end, the high end, or somewhere in the middle, but you usually can't operate over the entire band without an antenna tuner or transmatch.

The antenna I'm describing has a low SWR over almost all of the band. The SWR is less than 2:1 from 4.0 MHz. Down to 3.58 MHz! Below 3.58 MHz it's still below 2.5:1. You don't need to keep retuning a box to use this antenna. A single coil-and-capacitor matching section is used to connect the coax to the antenna.

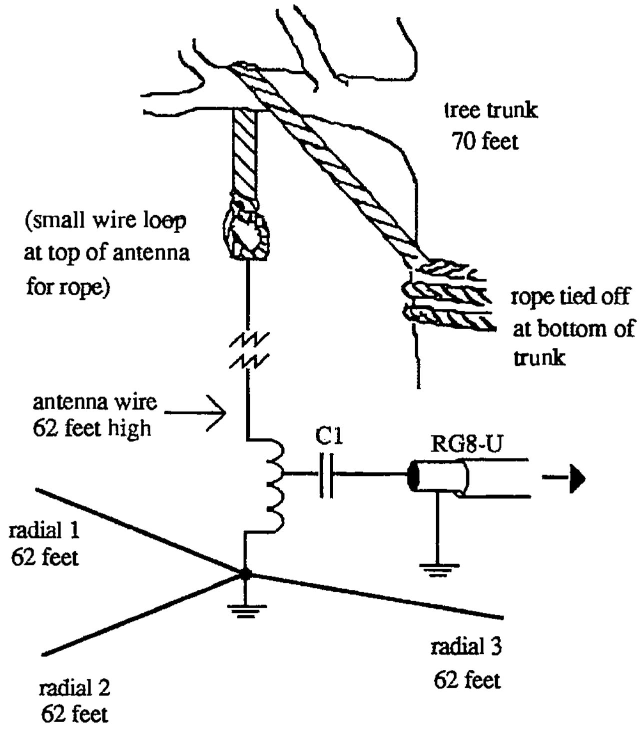


Fig. 1. Construction details.

Construction

Using a slingshot launch (with a 50-pound fishing line and a two-ounce lead sinker), I pulled up a 62-foot length of wire. I intentionally made it shorter than a quarter wave. This antenna needs a coil at the bottom to resonate it on 80m. The coil is inserted between the bottom of the vertical wire and the ground, as shown in **Fig. 1**.

The ground connection is a metal stake driven four feet into the earth near the bottom of the antenna. The antenna is always grounded for DC. Three 62-foot radials are laid on the ground. They can be buried or raised above the ground a few inches, whichever is more practical, but don't raise them very high (you will understand why very soon).

I used an old piece of coil stock (B&W #3022, and 16 microhenries, according to the label). The original coil was 14-gauge wire, eight turns per inch, one and three-quarters inches in diameter and four inches long. Four turns had broken off, so it was only 14 microhenries when I checked it on the inductance meter.

The bottom end of the coil was connected to the metal stake and the top end to the antenna wire, which was hanging down from a branch. Holding my dip meter next to the coil I found that the system resonated at 3.75 MHz.

Tuning

Matching this to the coaxial feedline was easier than I expected. Since the feed point is right at ground level, you can adjust the match until it is exactly what you want without raising and lowering the antenna for each adjustment.

Using a QRP setting with 5 watts output on my Century 21 rig and operating at 3.75 MHz, I connected the rig to the top end of the coil with a two-foot piece of 52-ohm coax through the SWR bridge. The shield of the cable and the ground lug on the Century 21 transmitter were both connected to ground. The SWR bridge was right at the transmitter output.

At first there was a high SWR. The coil at the base of the antenna required a capacitance to compensate for the inductance. I tried various sized surplus capacitors at the point where the feedline was attached to the coil, in series with the feedline.

The voltage is low at this point when the antenna is resonant. This means you can use any variable capacitor, even one with a low voltage rating, without worrying about it arcing between the plates. However, you will need a large amount of capacitance.

It took 600 pF to match the feedline to the antenna, and a tap down the coil eight turns from the top with the feedline connection. That gave four microhenries above the feed point (between the feed point and the bottom of the antenna wire) and 10 microhenries below the feed point (between the feed point and ground).

Each adjustment was recorded on paper, with its SWR, so that if I went too far in one direction, either in tapping on the coil or adding or subtracting capacitance, I could go back to where I had been.

The results

The tree branch was actually higher than the length of the wire, so I doubled over some of the fishing line. This gave me the safety of having the high RF voltage, at the top end of the antenna wire, a little lower than the tree limb supporting the antenna. Thus, no arcover was likely to occur from wire to wood if things got damp up there.

The actual SWR readings (checked at the feed point, at a point halfway between the antenna and the shack, where the remote coaxial switch is located, and at the shack connection) were: 1.6:1 at 4.0 MHz, 1.4:1 at 3.9 MHz, 1.1:1 at 3.8 MHz, 1.4:1 at 3.7 MHz, 1.9:1 at 3.6 MHz and 2.5:1 at 3.5 MHz.

Photo A. WØRKU's 80 meter vertical, with its "outhouse" enclosure.

The antenna works throughout the entire 80m band at full power, without the use of a tuner. Since I'm new to digital radio, I have recently been using it at 3604 kHz for the Midwestern RTTY net and some PACTOR contacts between 3600 and 3620 kHz, with excellent results.

Its performance on the DX portion of 80m (3690-3700 kHz) is excellent. The best DX contact was Croatia on 3694 kHz. Some of my contacts say "strong signal," without my asking for a report.

It's also excellent for rag-chewing on 75m. The Breakfast Club net control on 3973 kHz gives me good signal reports, even when he can't hear some others.

To keep moisture and dirt out of the coil and capacitor network, I constructed a little cedar box (see Photo A). The roof is sloped for water runoff, and it looks like a little "outhouse" for squirrels. I haven't cut out the crescent moon on the front door yet, but I did put a lock on the door! 73

73 Review

Now You See It, Now You Don't

You won't get stuck with this TapeTenna antenna kit.

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I'm not an old-timer, precisely, but I fondly remember when the letters "CCR" stood for "Credence Clearwater Revival," and not "Conditions, Covenants, and Restrictions." Nowadays, PRB-1 notwithstanding, more than half of us live in places where they threaten to take you to court if you put up something that even looks like an antenna. Since we hams are inventive by nature, there have been all kinds of solutions to this problem, usually involving an attempt to make an antenna look like something else. HAMCO's TapeTenna kits make it possible to build real antennas, and make them disappear.

We're also intelligent consumers. Lemon products don't survive long enough to get reviewed, so I expected TapeTenna to work in accordance with its advertising promises. I was surprised, though, by the extent to which it exceeded its claims and the amazing applications I have found for the material in and around my shack.

TapeTenna secrets

The first secret to the TapeTenna kit is of course the tape itself, a highly conductive self-adhesive copper foil. The kit includes an instruction manual, connectors, and a generous amount of the tape—two rolls, for a total of 216 feet, so you will have enough for an 80m dipole and several other antennas. TapeTenna tape is pure copper, half an inch wide by about 3+ mils (.0035") thick, with a high-tech adhesive that will stick to just about anything, including bare masonry. The basic idea is that you use it just like wire except that you stick it onto things—walls, windows, roofs, chimneys—rather than hanging it between supports. And the tape is paintable: Once you've stuck the tape onto the wall of your apartment, for example, you can paint over it and it will literally disappear. The adhesive is conductive, so you can make connections simply by sticking one piece of tape to another. And since it is pure copper, it solders like a dream.

The second secret is the comprehensive instruction manual, which includes designs and specification for lots of different antennas, and a lot of basic antenna theory which will give you the basis for experimentation. There are diagrams to clarify the instructions, and a beginner will be making effective stealthy antennas in no time. In fact there is so much useful information about antenna design and construction that it wouldn't be going too far to describe the TapeTenna manual as a concise antenna handbook.

"It's an idea that seems so obvious you have to wonder why it hasn't been done before."

The third secret is the huge range of non-antenna uses you can find for the tape. The manual gives some indication of this, with coils wound on PVC pipe, open "wire" feedlines, etc., but it seemed for a while that I was finding a new use for it every five minutes. For example, I had an RF shielding problem with a device in a steel box. Running TapeTenna tape around the inside of the box fixed the problem. And in the process of removing a circuit board component, I pulled a little piece of track off the board—fixed it in about 30 seconds with a tiny TapeTenna "band-aid."

Traditional antenna designs

I built a couple of the antennas described in the manual, and they worked perfectly—it really is just a matter of using the tape instead of wire. There are some limitations, of course. I suspect that at UHF and above the width of the tape might become a factor in calculations, and of course you do need something to stick it onto.

Photo A. The TapeTenna.

My first project was a 2m J-pole which is stuck to the side of my chimney. I was expecting a bit of directionality due to the closeness of the chimney, but it appears to be "radio transparent." I also built a "roll-up" J-pole for use with my HT when traveling. It's a six-foot strip of vinyl with the antenna stuck onto it, and a connector at the bottom end. The whole antenna rolls up into a cylinder measuring about an inch in diameter by five inches long. I can hang it up near a window in a hotel room in about 10 seconds flat. J-poles are great 2m antennas and it's no surprise that HAMCO now offers a separate "Tape J" kit.

The other tape antenna I built was a 20m dipole which is stuck to the ridge of my roof. Due to stray capacitance (induced by nails in the roof, impurities in the shingles, etc.), it will be necessary to adjust the length of a dipole as compared with the free space calculations, but adjustment is a snap—you shorten it by cutting with a utility knife. If you need to lengthen it, you're in for a pleasant surprise if you've ever had to splice wire—with TapeTenna you just stick another bit onto the end!

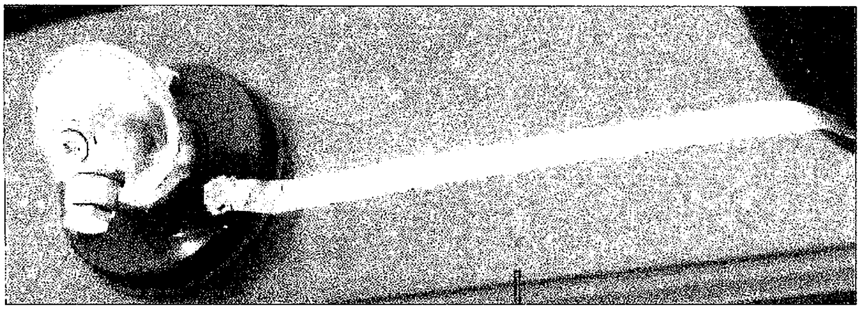

Photo B. TapeTenna mount on a plastic van. TapeTenna copper tape provides the ground.

Going mobile

I have a particular problem with mobile antennas—my vehicle is a Chevy Lumina APV. "APV" is supposed to mean "All Purpose Vehicle" but it also stands for "All Plastic Vehicle." The body is made entirely out of composite materials. Nothing even resembling a ground plane for a radio antenna. TapeTenna to the rescue! For years I put up with a poorly performing quarter-wave vertical for 2m. It was mounted on one of the side windows using a "trunk lid mount" and the addition of three copper tape radials made a substantial difference in its performance. In order to reduce the "visual impact," I cut the tape in thirds lengthwise and applied one of the three radials more or less horizontally on the top of the van, and the other two running down the window at 45 degrees from the mount.

Another option, described in the manual, is an inverted V stuck onto the back window. And I've calculated that I could stick a 10-element beam on the roof, with a gamma match made out of, well... tape!

2m mobile antennas are easy. In contrast, HF mobile looked like it was going to be impossible. All HF mobile antenna designs assume that there is a lot of metal in close proximity to the base of the antenna. You can argue all day over whether the car body is acting as an RF ground, an elevated ground plane, a counterpoise, or some combination of the above. Doesn't much matter if you don't have any metal to start with. I found very quickly that in my plastic van, the chassis does *not* do the job. Period. What few metal components there are appear to be electrically isolated, and in fact all electrical components are grounded by wire back to the battery rather than through the body or chassis. Solution? I ran a continuous strip of TapeTenna material around the bottom outer edge of the van, following the contours of the wheel wells and bumpers, and connected it to the "grounded" bolts of the antenna mount. SWR immediately dropped from 3:1 to 1.2:1 on 10, 20, 30 and 40m, the bands for which I had resonators. I doubt this is a permanent solution because the tape is exposed to water, dirt, and other road hazards, but it has held up for several thousand miles and, when it becomes necessary, it will be simple enough to replace it with a similar loop inside the van.

A thousand uses?

If there is ever a ham radio Scheherazade, she could entertain the Sultan with a thousand and one stories about using TapeTenna. It's an idea that seems so obvious you have to wonder why it hasn't been done before. Well, some of it *has* been done before, with burglar alarm tape, or copper foil tapes designed for other purposes, like stained glass work (extremely expensive and with questionable adhesives). These alternatives are often less than a third of the thickness of the TapeTenna material and correspondingly less likely to withstand mechanical stresses. In fact, burglar alarm tape is *designed* to break! It's hard to solder aluminum, and the copper tapes are expensive, with adhesives of debatable durability. TapeTenna brings it all together with a very specialized tape material at a reasonable price, with a wealth of good ideas and instructions.

Availability

TapeTenna kits are available ($64 postpaid, Tape-J kit $23 postpaid) by mail order *only* from: HAMCO, P.O. Box 25, Woodland Park, CO 80866.

NEVER SAY DIE

Continued from page 27

article for possible publication in *73* to help newcomers to the field? They need to know the suppliers, the publications, have a list of recommended books, how distribution works, what frequencies and services are available and their average costs ... things like that.

If we can get a series of articles to help *73* readers come up to speed on business communications services, that'll help a bunch of hams build some spare-time income, and maybe be able to take their new consulting businesses full-time as entrepreneurs. So what's out there in BBS software? In security products and services? In video conferencing? Satellite services?

Or are you happy with your old ham gear and not enough money even to buy a subscription to *73*? Tsk. The money is out there in great big gobs, you just have to make a little effort to grab it. And that means turning off the ball games and doing some homework instead. Get off that couch, put down that can of beer, brush off the pretzel crumbs, and get cracking. I don't care if you're 20 or 70, you can learn new things and it'll be some of the best fun you've ever had. Heck, I'm 74 now and I'm tackling a whole new branch of physics ... one which not even the best scientists in the world understand yet ... cold fusion. Now *that's* exciting.

I'd love to know more about communications, so I'll be reading any articles submitted for my own edification as well as yours. That means they've got to be simple enough so I can, duh, understand them.

Cover Contest

An old ham friend of mine, who is probably libido-challenged, suggested that I run a cover photo contest for hams with gorgeous wives, daughters, or granddaughters clad in swimsuits doing ham things. Well, it works for *Sports Illustrated*, so what the hell! Keep in mind that a vertical format fits the cover best, even if the young lady prefers more horizontal activities. Was it Cleopatra who said, "I'm not prone to argue?" If your model has a call, so much the better. Hey, I mean a ham call, not a pager number. Send her up your tower, or maybe a hilltop with an HT—heck, use your imagination.

I can make do with 35mm, but a larger negative will make a sharper picture if you can borrow a good camera. Let's see what you can do! Watch out, *Playboy*.

"Anyone Can Talk"

In editing an article on keeping CW alive I can across that observation by the author. Well, yes. But in my 48 years of on-the-air experience, very few people have bothered to learn how to talk interestingly to strangers. Somewhere around 90% of the contacts I've made could have been made with a recording, at least until I've managed to blast

Continued on page 37

Number 34 on your Feedback card

Morse's Code

How the Tech's terror was invented.

Beth Price KC8ALW
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Samuel Finley Breese Morse tried everything. In his 81 years of life he was an artist, inventor, photographer, teacher, and he even ran for Congress and for Mayor of New York City. Even so, he was poor until fairly late in life. Morse was a fascinating man—a real genius. So how did he get the idea for the telegraph? For Morse code?

He was born in 1791 in Charlestown, Massachusetts, the oldest of the three children (out of 11) who survived. His father, Jedidiah, was a minister, the author of the first book of American geography, and a friend of George Washington. His mother, Elizabeth, had a grandfather who was president of Princeton College.

As part of a family tradition, he went off to Yale College at 14, where he was very bored. Only the electricity classes held his interest. In class he even made his own batteries. However, he had always wanted to be a painter, so when he graduated in 1810 he went to study art in Europe, funded by his not very enthusiastic parents. He developed into a very good painter and several of his works were accepted by the Royal Academy in London. In 1832 he ran out of money and headed home.

On the voyage home, he got to talking with some of the other passengers about sending messages by electricity through wires. This excited him so much that he spent the rest of the trip making notes and drawing diagrams for an invention he called the "telegraph."

Once home, since no one wanted paintings of landscapes or mythical heroes such as he had painted in Europe, he had to resort to painting portraits. While traveling from town to town he met and married Lucretia Walker. They soon had three children: Susan, Charles, and Finley. Supporting his family while working on his invention was difficult, so he invented a water pump for firemen and a marble cutter. He even turned to teaching painting and photography. One of his photography students was Mathew Brady, who would later become famous for his Civil War photographs. Later on, Morse even painted President Monroe, the entire Congress, and Marquis de Lafayette, a French general. Even so, most of his money went into developing the telegraph.

However, before the telegraph was finished, Lucretia died. Morse, heartbroken, left his sons with his brothers and his daughter with Lucretia's sister and went back to Europe to paint.

He returned to the United States to market his telegraph, demonstrating it in 1837 to a group of influential men. Only one of them, Alfred Vail, was interested in financing it. Vail agreed to become a quarter partner with Morse, to help him build a sturdier model. Soon, Morse took on two other partners, Leonard D. Gale, and Joseph Henry, a scientist, to help him.

"The telegraph was invented at a time when most people didn't know what electricity was."

The telegraph

It was a simple design, but it was his own. He made his own wire by soldering little pieces together and wrapping them with cotton thread for insulation. The invention itself was a long wooden strip with notches filled with metal on top, which was called a port-rule. The port-rule was underneath some electrical contacts. When it was drawn underneath them, it caused the contacts to open and close, opening and closing an electrical circuit. Morse had 1,700 feet of wire strung around the room where he experimented, ending at a receiving site, where it recorded a dot-and-dash-type message on a strip of moving paper tape. The tape was drawn by a clocking device. A pen directed by an electromagnet wrote the dots and dashes. However, the port-rule was slow, a problem which led to the invention of the faster-operating code keyer.

In 1842, Morse and his partners set up another demonstration, this time with several miles of wire stretched underwater from Battery Island to Governors Island in New York. Just before the demonstration the wire got caught in a ship's anchor, and when the anchor was raised, the crew cut the wire. Morse's invention was thought to be a hoax.

Finally, Morse got to show his telegraph and code to the United States government in 1844. The wire was strung from Washington D.C. to Baltimore, over 37 miles of land. He tapped out his now-famous message, "What hath God wrought?"

From then on life was easy for Morse—money was no longer a problem. In 1848, Morse was married again, to Sarah Griswold. Together they had four children, and Morse bought a mansion near Poughkeepsie, New York. With spare time on his

hands, Morse ran for Mayor of New York City and for Congress (he lost both times).

Meanwhile, the telegraph's importance grew. Within 10 years of Morse's first message, 23,000 miles of wire were laid, and thousands more were laid each year. By the time of his death in 1872, the lines had stretched from California to India. Messages that would have taken two to four weeks to send by mail now took less than a day by telegraph. By the beginning of the Civil War the telegraph had become the mainstay of worldwide communication—though it had been invented at a time when most people didn't know what electricity was. Morse helped to start the way of life we know now.

Morse code

From the time Morse first got the idea for the telegraph to the time of its making, he also worked on codes. When he was working on the port-rule telegraph he even had a code book. In it, there were certain codes for different names, dates, and places. However, this really limited the contents of the message, and the code book was not practical.

Then Morse came up with a code that is now called American Morse code. This is a code consisting of dots and dashes (said as "dits" and "dahs") which stand for letters of the alphabet, numbers, and punctuation. Although American Morse is not used today, the code we do use has the same concept. Today, we use International Morse code. It's different from American Morse because there are differences in the code for letters. American Morse has spaces in between some elements of the code, and some dahs are longer than the normal one. In International, the dahs stay the same length. A dah is three times the length of a dit. The space between the elements of the code is the length of a dit. The space between letters is three times the length of a dit, and a space between a word is seven times the length of a dit.

Morse made the most frequently used letters the shortest and easiest to send. The letter E is the most commonly used letter in the English language, and it is a single dit. Letters like Q and Z are longer and more difficult to send. To figure out the frequency of the letters, Morse went to a local printer and looked through the print box. He wrote down how many pieces of type were on hand for the printer to use for each letter of the alphabet. However, most of the code came straight from Morse's head. He claimed that the hardest part of his invention was designing the code. 73

Note: Beth's mother, father, and sister are all hams. She wrote this as a school project and her father, Mike, thought it was something the local ham club might like to print in their newsletter. He was right, so this is a reprint from the *Radiogram*.

Top-Loaded Vertical for 2 Meters

A small antenna with capital T performance.

Thomas M. Hart AD1B
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Not long ago, I purchased a book by John Devoldere ON4UN titled *Antennas and Techniques for Low Band DXing* (1994, ARRL Publications). I was amazed at the variety of antennas used on the 160, 80, and 40 meter bands in the endless quest for a really BIG signal. One popular antenna design on these bands is a top-loaded or "T" antenna.

"If you are vertically challenged and need to compromise on physical dimensions, this antenna might be the solution."

Refer to **Fig. 1** for the basic shape of top-loaded antennas as well as the dimensions that I am using in my scaled-down version. In general, this class of device is characterized as a short vertical with top-wire loading. The difference between the actual height of the antenna and a natural quarter wavelength is approximately one-half the length of the top section. Due to real life variations in terrain, grounds, radials, construction materials, and all of the rest, a fair amount of cutting and pruning is usually necessary.

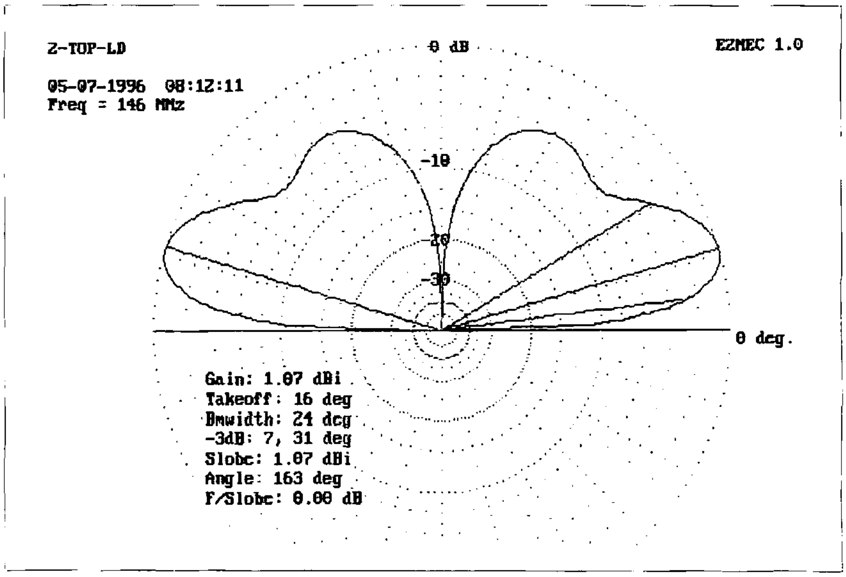

Fig 2. *Vertical-plane radiation pattern for the top-loaded vertical.*

My need for a 160 meter vertical is not too critical at the moment, but I really did need some help on the 2 meter band in order to work local packet stations. I am particularly interested in using the 145.69 contest/DX packet system at the QTH of Bruce WA1G. The horizontally polarized dipole on the top of my bookcase was not doing the job. Whatever replacement I developed had to fit into a 16-inch vertical space, which eliminated a quarter-wave ground plane.

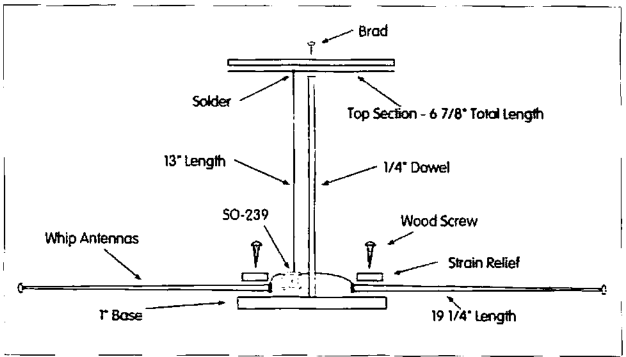

Fig. 1. *The 2 meter top-loaded vertical with 2 radials.*

Returning to the low band metaphor, I decided to try a top-loaded antenna with a 13-inch vertical section (this would be 0.667 times the quarter-wave dimension). I built a half-wave dipole for 2 meters, starting with insulated hookup wire elements cut to an initial length of 21 inches. Using a 2 meter SWR meter, I carefully pruned until I had an SWR of 1:1. This provided the physical dimensions for a quarter wave length. The end of the dipole attached to the center of the coax feed line was then cut to a length of 13 inches and a

top section soldered to the far end (at the center of the top section). The next step was to carefully trim the top loading section in order to return to an SWR of 1:1 using the previously tuned remaining dipole element as the other half of the antenna. The final step was to build a wooden frame to hold the newly tuned vertical element, add two horizontal radial counterpoises (collapsible whip antennas) and make the final adjustments. The final tweak was needed to restore the SWR to 1:1; this involved nothing more than setting the length of the two radials.

How does it work? I am quite satisfied and have been able to do my packeteering very nicely. The antenna was easy to build and cost only pennies. The accompanying antenna pattern generated by the EZNEC software package shows that the antenna is omnidirectional and has a low take-off angle, both very desirable for my application. The top loading avoids the mechanical and electrical problems associated with building and using coils at the base or midpoint of a short antenna. The use of collapsible whip antennas as radials simplifies the construction as well as the tuning, and provides rigid elements. If you are vertically challenged and need to compromise on physical dimensions, this antenna might be the solution. 73

Manufacturers if you would like to have your new products reviewed in 73, please call Fran at 800-274-7373 for details.

NEVER SAY DIE

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the other chap out of his rut—if you call the Grand Canyon a rut.

Being good at anything takes work and practice. Even sex. And being good at talking on the air is no different. I have never found a skill of any value that didn't take a lot of work and practice. Flying, horseback riding, scuba diving, skiing, and so on are not God-given talents, they're skills, and so is the "gift of gab." It's a hard-won and very valuable "gift."

Let's be honest, oh great communicator, have you ever tape-recorded a few of your contacts and then listened to them critically later? Of course you haven't, or else you'd have done something about the situation a long time ago. "The rig here is"—oh, good grief!

Pointers

When you read the newspapers and magazines, look for interesting items and cut them out. Read 'em over a couple of times so you'll be able to talk about them. The "Only In America" series in Seligman's *Fortune* "Keeping Up" column has great fodder. "Hey, did you read about ... ?"

Unless you've done almost nothing to take advantage of the opportunities amateur radio has provided you for adventure, you should have at least a few interesting stories to tell. Make notes and post 'em where you can see 'em when you're operating. Remember, when you're talking with someone you owe it to them to keep your attention focused on what they're saying, so you're not going to have a lot of time to organize your thoughts. Having some reminders posted helps.

It's a little late now, but you might get your grandchildren started in the right direction by suggesting that they start keeping a collection of the jokes they've heard—otherwise they're going to forget 99+% of 'em. No good salesman is without a solid opening joke, and you shouldn't be either. Hey, did I ever tell you about the RPI grad who was in line for the guillotine when the contraption stopped working? "Hmm, maybe if you tighten that little screw up there."

I'm reminded of the RPI physicist who called in while I was being interviewed by Art Bell on his Coast-to-Coast radio show back in May. I'd been explaining about cold fusion developments and he called in to tell me that cold fusion was impossible because there were no gamma rays being detected. I tried to explain to him that when experimental results conflict with theory, it is theory which should give way. No sale. The listeners loved it.

The most important aspect in making your contacts interesting is to listen and ask questions. The more you get the other chap talking about himself, the more interesting the contact is going to be for him. If you listen to me on the air I'll give you clues on things to ask about, but I'm going to be asking you a lot of questions. Like what kind of work did you do before you retired? Are you doing anything now that takes advantage of the skills you built while you were working? Stuff like that. And if I find any area of mutual interest, we'll have a memorable contact.

Yes, I had fun working new countries when I first got a big antenna up in the air and could work anything I could hear—and could hear everything. But now I'm into quality instead of quantity. I haven't counted how many countries I've worked in years. Sure, I used to go through a country list and check off all those I'd worked. Now I just check off those I've visited.

Sometimes I don't get anywhere getting the other guy to talk, no matter how I try. A

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The Magical Audio Filter Revisited

Updating a dandy little receiver helper.

Jim Pepper W6QIF
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Almost any receiver can be improved by the addition of an outboard audio filter, whether for CW or phone reception. A good filter can help you hear the stuff you want to, and get rid of the garbage that's interfering.

An article of mine in the November 1983 issue of *73* (Jim Pepper W6QIF, "The Magical Audio Filter," page 14) resulted from my looking for a null and peaking circuit. I found a design in the *National Semiconductor Linear Applications Manual* that provided a nulling circuit (January 1972, pages AN31-14). It turned out that it also had, as an integral part of the design, a peaking circuit. I modified their design to use a variable resistor rather than a capacitor to vary the null frequency.

Several readers wrote to say that the circuit worked well, but they had some trouble with the circuit oscillating. This was primarily due to the output stage, an LM-383. Since then I've made some improvements, so the circuit now produces a filter with an attenuation of almost 50 dB at 2 kHz, as compared to the original 20 dB. Now I'm using an LM-386,

"It's an easy weekend project."

which gives a very stable, though reduced, output. To get the increased selectivity I added one more stage to the circuit. I used a Max-295, an

***Photo A.** Magical Filter II, front view.*

8th-order, low-pass switched-capacitor audio filter (SCAF), which gives approximately -50 dB per octave, as compared to -6 dB for a single-pole filter.

There are two positions for the filter: one rolling off at approximately 1 kHz for CW, and a second at 2.5 kHz for phone. The two positions are front-panel selectable by NB/WB switch (S3). See **Figs. 1A** and **1B** for the response curves. The response curves were derived from voltages measured at the output of the LM-386 and compared to the voltage from an audio oscillator output. Since the output circuit also contributes to the rolloff, I chose to set the volume pot at a point where the output voltage of the LM-386 was equal to the voltage from the audio oscillator (the LM-386 has a gain of 20 dB.). The reference voltage was also chosen when the frequency was 1 kHz.

The null circuit is the same as my original design. It is used to eliminate steady carriers, but is a little difficult

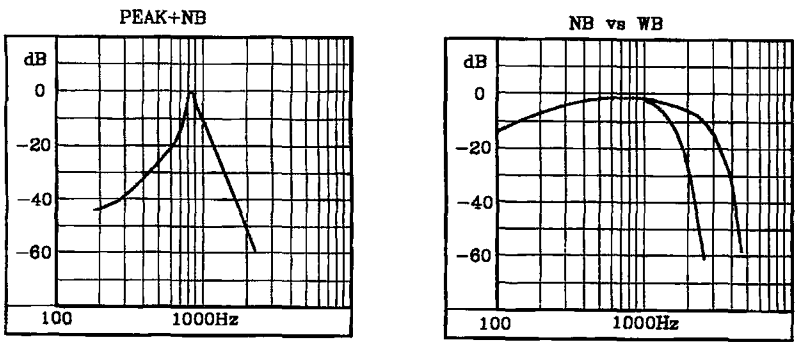


***Fig. 1.** Response curves for the two filter positions. **A)** Rolling off at approximately 1 kHz for CW. **B)** At 2.5 kHz for phone.*

to use on CW signals because it is so sharp and provides about 20 dB of attenuation.

The peaking circuit is still maintained and the peak frequency is front-panel adjustable, varying from 500 Hz to 1500 Hz, and centered around 800 Hz. It provides about 20 dB of peaking. To prevent my having to jump to the volume control when it is switched in, I put in a fixed attenuator to drop the incoming signal by 20 dB. Thus, when the receiver is tuned off to the side of the signal, the background noise is also reduced by this. factor. The peaking circuit can be turned off for phone reception by closing S1.

This outboard filter circuit is designed to be plugged into the headphone output of the receiver, so no additional internal wiring changes are necessary. The LM-386 provides plenty of output to drive a speaker. The input to the unit is controlled by the receiver volume control and is set to prevent overloading the filter circuits and output stage. An additional gain control (audio pot) is available on the front panel to control the output level of the unit. The control is designed to be either AC-operated or from a 9 volt battery.

The unit is made on a PC board (available from FAR Circuits, 18N640 Field Court, Dundee IL 60118) and housed in a 4" x 3-1/4" x 2-3/16" metal enclosure. The parts location is silkscreened on the PC board to aid in construction. There is only a minimum of wiring necessary, which includes wiring the front panel switches. The pots and transformers are mounted on the PC board.

The hole diameter for the switches on the panels is 1/4", and 5/16" for the pots. As an aid to drilling, I found that a piece of 2x4 lumber inserted in the chassis makes an excellent backing for drilling.

Mount all PC board components and wire the front panel switches and speaker jack before putting the board into the box. It's a good idea to check the unit's operation before inserting it in the box. The AC wiring and the wire for the speaker plug can be temporarily connected to the PC board at this time. (Note: Be sure that the body of the male phone plug goes to the ground on the board. The tip goes to the input point.)

To help support the PC board if the transformer is used, use 6-32 screws 3/8" long, mounted as indicated, with the head on the top side of the PC board.

Preliminary testing

Before plugging in the ICs, it is best to check the various voltages on the board. Plug in the AC cord and turn on the AC SW. If the unit is still in one piece you can check the voltages at the regulators. Also check the voltage on pin 7 of the Max-295 (IC3); it should read no greater than 10.5 volts. The SCAF is rated 11V max. If the voltages are correct, turn off the power and insert the ICs. All number 1 pins of the ICs go to the rear of the board.

Connect the input plug to the receiver output and plug in an external speaker or headphones. Turn on the receiver and filter. Set the filter audio gain to about one-third on. Place the filter in the bypass position (S2 in FILTER OUT). Turn up the receiver volume control to a good listening level with a CW station tuned in. If the signal is breaking up on peaks, the input is too high.

Set the PEAK switch (S1) to OFF or closed position and the bandwidth switch (S3) to WB. Tune the receiver to a fairly loud CW signal to your desired copying pitch. Switch (S2) the filter to the IN position. Turn the PEAK switch (S1) to ON, or open position, and adjust the PEAK control to give the loudest volume. There should be a pronounced increase in volume if the circuit is working correctly.

Next, tune the receiver off frequency from the CW station to about 1.5 kHz higher. Change the WB/NB switch (S3) to NB. You should note a change in the signal level. Switch out the peaking circuit and note the increase in background noise. Now rotate the NULL pot in a clockwise direction. At about the three-quarter position you will find that the signal reduces in volume. If all these tests work as expected, it's time to put it in the cabinet.

Copy the drawing for the front panel by placing it on a clear laminating material (available at stationery and variety stores), cutting it to size. Be sure the drawing is full-scale. I found that if I stuck the artwork on the panel with

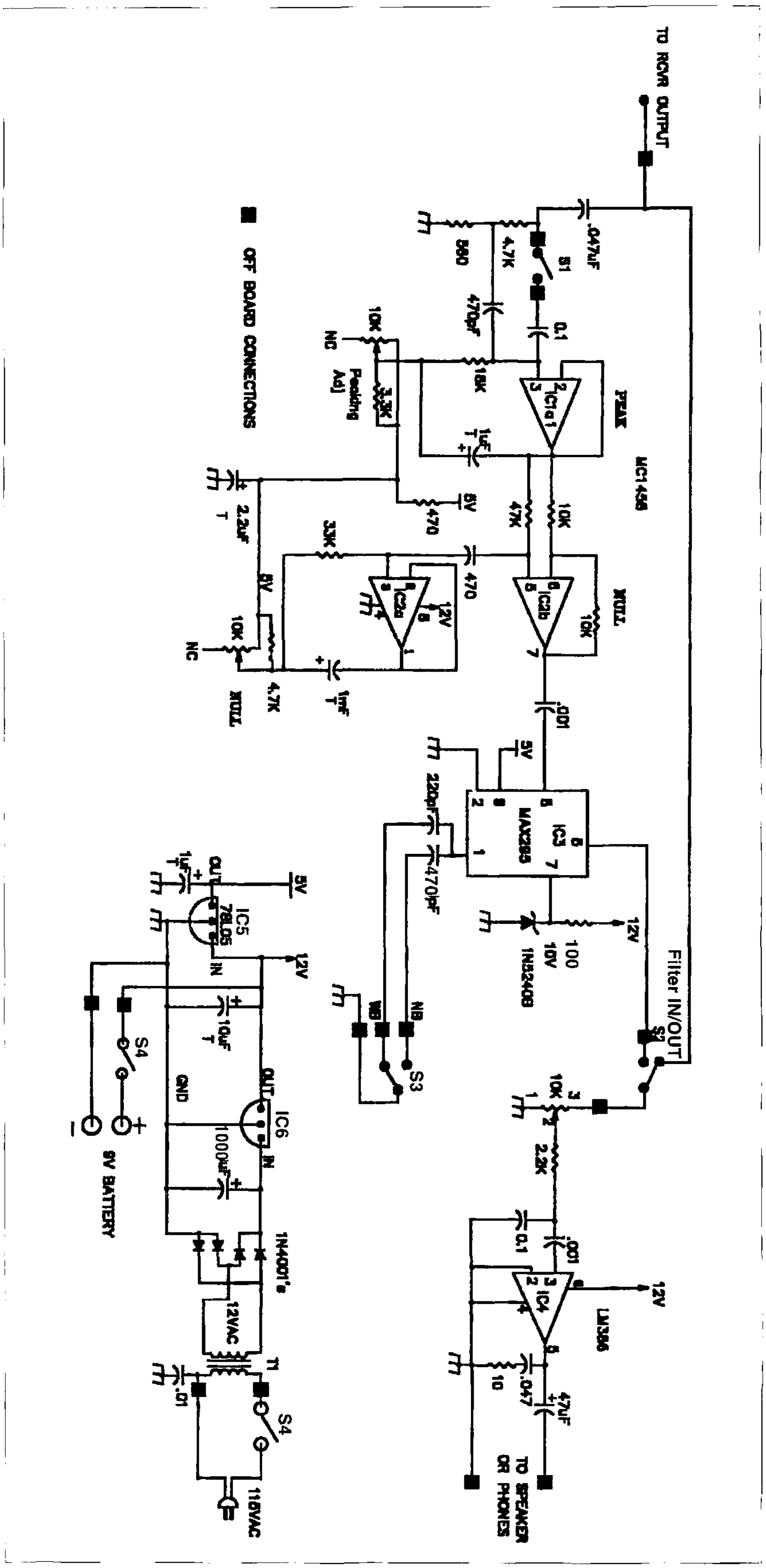


Fig. 2. Schematic for the Magical Filter II.

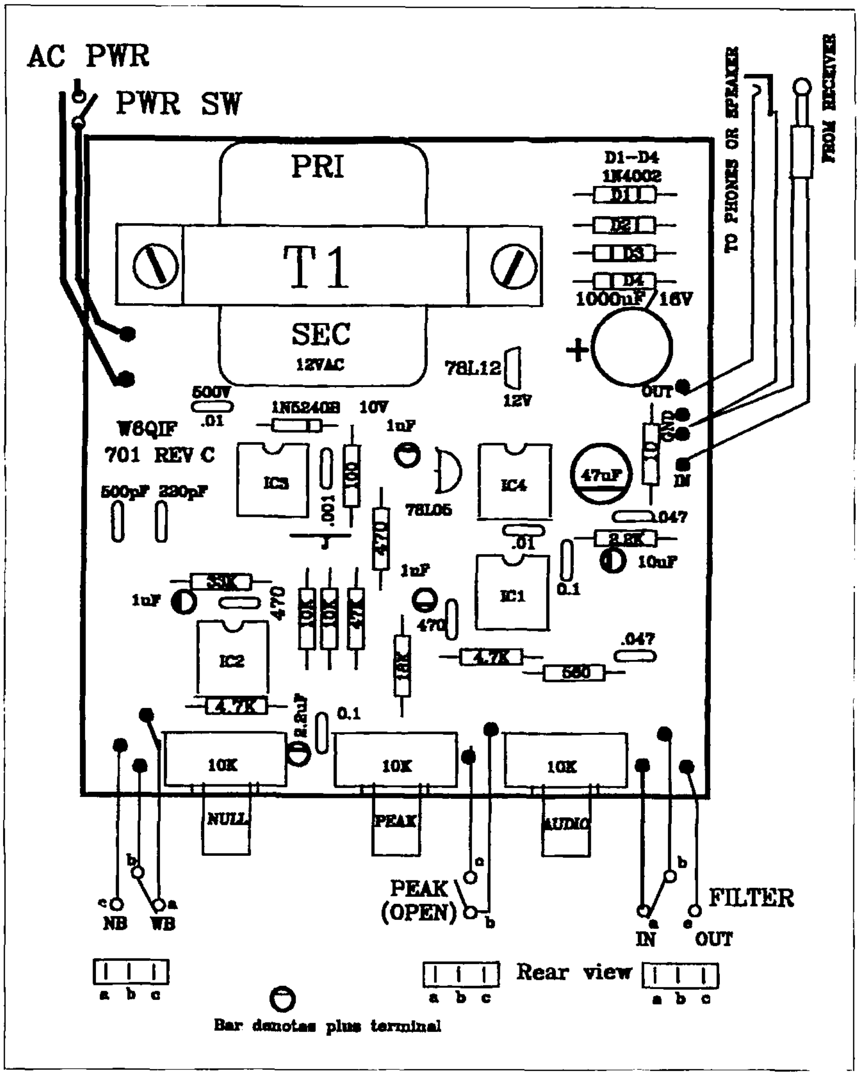


Fig. 3. Magical Filter II board parts placement diagram.

a thin coating of white carpenter's glue it was easy to cut out the holes for the pots and switches with a hobby knife.

Next, connect the AC wiring and speaker plug as shown on the assembly drawing. Prewire the two cables through the rear panel before you insert the PC board; this way the connectors can be left on the cables. Be careful that the AC switch terminals do not touch the transformer frame.

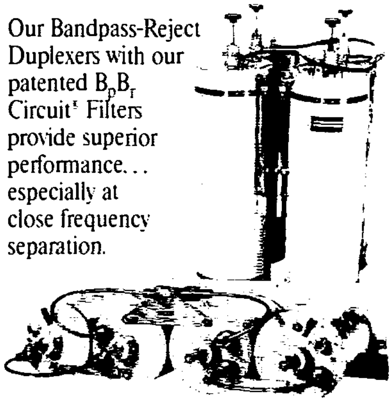
It will be necessary to place 1/8"-thick space washers on the three pot shafts to properly mount the PC board to the front panel. The PC board pots will slide into the front panel and nuts can be applied at this time. The front panel switches can also be mounted now. Be sure they are properly oriented to comply with the panel labeling. If not, they can always be rotated later on.

Battery operation

If you want to use the filter for portable operation you can replace the transformer with a 9V battery. The battery can be held in place by a wire soldered to the holes available for the primary and secondary leads to the solder pads of T1. Connect the battery *minus* lead to ground and the battery *plus* lead to ON/OFF switch S4. The **Parts List** indicates which parts can be left off. A worthwhile addition might be an LED to indicate when the battery power is on. If both types of operation are contemplated, an external connector for a battery can be used.

Conclusion

I have used this unit with my direct conversion receiver as well as with my FT-840, and have found it very useful.



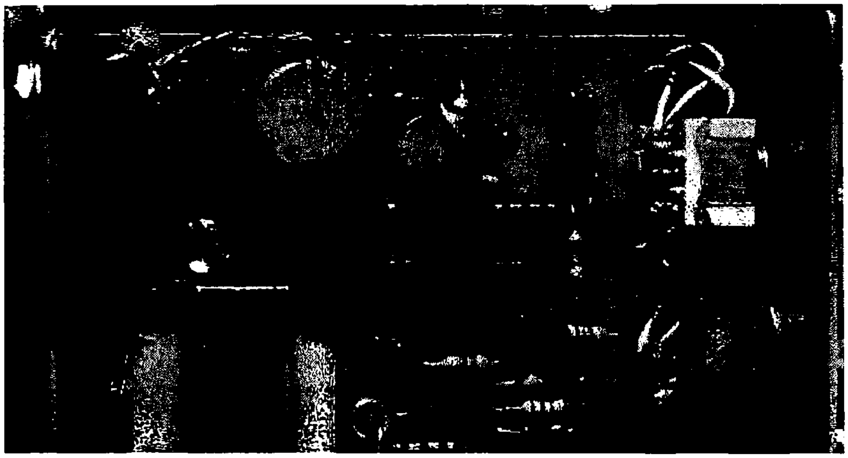


Photo B. Inside view.

My 840 does not have the CW filter, but this unit does a job that is almost as good. You might want to improve the NB position even more on your filter. This can be done by changing the 470 pF capacitor, which is connected between Pin 1 of IC3 and the NB position of S3, to 620 pF. This project is a way to improve any receiver's selectivity for a minimal cost, and it's an easy weekend project.

Parts List

Instrument Box 40UB101 (D)
IC1, IC2 Op AMP 1458 - MC1458CP1 (D)
IC4 Audio AMP LM386 - LM386 (D)
IC6* 12V regulator - 78L12 (D)
IC5 5V regulator - 78L05 (D)
10k pot (3 required) - 31CW401 10K (D)
1N4002* Rect (4 required) - 1N4002 (D)
10Ω 1/4W 5% resistor
100Ω 1/4W 5% resistor
470Ω 1/4W 5% resistor
560Ω 1/4W 5% resistor
2.2kΩ 1/4W 5% resistor
4.7kΩ 1/4W 5% resistor (2 required)
10kΩ 1/4W 5% resistor (2required)
18kΩ 1/4W 5% resistor
33kΩ 1/4W 5% resistor
47kΩ 1/4W 5% resistor
.001µF capacitor (2 required)
470pF Cer 5% (3 required) - 21CB470 (D)
047µF Mylar™ (2 required) - 23BK347 (D)
0.1µF Mon-Cer (2 required) - 110Z5U104K50V (D)
1µF Tantalum (3 required) - 18EM510 (D)
2.2µF Tantalum - 18EM522 (D)
10µF Tantalum - 18EM610 (D)
47µF Elect Radial - CEM16-0047 (D)
1000µF Elect Radial* - CEM16-1000 (D)
.01µF cer disc 500V
S1, S2, S3, S4 SPDT switch
Phone Jack 1/8" - 16PJ011 (D)
Phone plug 1/8" - 17PP102 (D)
8 pin socket (4 required) T02-08 (D)
9V Battery snap - 12BC010 (D)
12V trans PC brd* - 273-1385 (R)
9V Battery
Panel Laminate 65059 - C-Line Product (variety store)
IC3 MAX295CPA Filter
10 volt zener* - 1N5240B (D)
2 3/4" Knob (4 required) - 274-415 (R)
1 1/2" Knob (2 required) - 274-220 (R)

(D) = DC Electronics, Box 3203 Scottsdale Arizona 85271 (+ S/H $4.00)
(R) = Radio Shack

* Delete if 9V battery is used.

PC Board (Magical Filt 701 Rev. C), available from: FAR Circuits, @$6.00 + $1.50 s/h (per total order). FAX orders accepted (847) 836-9148; Visa/MC orders please add $3.00 service charge per total order.

NEVER SAY DIE

Continued from page 37

chap the other day had been retired for years and the highlight of his day was going out to lunch with his wife. Other than that it was playing golf. Period. Sigh.

Of course if all you want to do is fill in year after year of signal reports in your log, that doesn't take anything but time. Yes, I did that for a while. Been there, done that. Ditto the 75m net where nothing of substance ever was discussed. Done that too. Well, it does give you a feeling of belonging to a group. But that was 50 years ago and W1KPL, W1MLJ, and W1IF are all long gone. They're all Silent Voices now. They smoked. Oh, W2MSV was fat, so he died young. Ditto W2MAM.

If you're short on interesting things to talk about, read a book! Read any one of the books I've reviewed in my past editorials, or those on my $5 list of books you're crazy if you don't read, and you'll be well armed to talk anyone's ear off. Hey, read the NASA book and drive everyone crazy about the Apollo shots all being bogus. They may think you're crazy to believe such obvious nonsense, but you'll be well armed if anyone actually wants to discuss facts. Most don't. But then Galileo couldn't get people to look through his telescope and Pasteur had the same problem with his microscope. Little tiny germs? Preposterous!

A Terrible Business

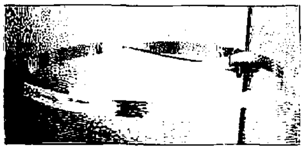
When Chuck Martin WA1KPS told me he was going into the ham radio business as a dealer I warned him not to do it. I explained that it was probably one of the worst businesses he could go into. Thus was Tufts Radio launched. Well, Chuck eventually found out for himself what he'd gotten into. His love of amateur radio was stronger than his sense of reality and overrode my warnings. Yes, he eventually went bankrupt.

In a recent editorial I pointed out that ham dealer margins are far below those of almost any other business. I cited a figure of 25% instead of the more normal retailer 50% minimum. Well, it didn't take long before a few ham dealers put me straight. I was wrong. Yes, Uncle Wayne mis-wrote. I was assured that the margins for ham dealers on most rigs is more like 7%. And out of that comes 2% for the credit card and 1% or so for freight costs. This is gross profit, not net. The dealer still has plenty of overhead that has to come out of the 4% he has left. Like the store rent, warehouse space, taxes, insurance, personnel (including health insurance), heat, light, water, building maintenance, advertising, telephone, copiers, computers, bookkeeping, office supplies, shipping materials, and so on. Having built a chain of computer software stores I know the drill on retailing.

Do I have an answer for this? No, I'm stumped. It's illegal for the dealers to get together and set prices so everyone can make a buck. And, as a consumer, I'm not about to pay more for something than I have to, so when one supplier has a lower price, that's where I buy. And I'm willing to forego some service to save money.

Continued on page 52

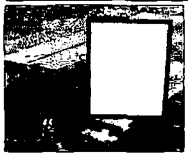
NEW PRODUCTS



Try On This Halo

The Homeowners' Association Gestapo giving you static about your antenna? Want to work real ionospheric skip DX on 6 meters? Here's a heavenly new item from Advanced Electronic Applications, Inc.

The HALO-6 will allow you to use your new multiband transceiver on 6 meters at the lowest possible cost. It comes as an easy-to-assemble kit—about 30 minutes to put it together—for $69! It's so flexible it can squeeze through attic openings and other tight spaces; you can even support the antenna with fishing line in your attic. The higher you mount the HALO-6, the higher performance you will realize. Minimum mounting height is six feet, great for mobile users and antenna-restricted operators. No matter how you mount the HALO-6, you'll benefit from its omnidirectional radiation pattern and its low angle of radiation. See your dealer or call AEA's 24-hour Literature Request Line at (800) 432-8873 for more information.



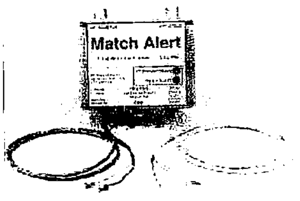
Ham-Panel 440

And now for something completely different: Ant-Panel Products has just come up with this intriguing antenna panel. Only 18 by 24 by 2 inches thick, the Ham-Panel 440 is a high-performance 90° beamwidth antenna with a VSWR less than 2:1 from 435 to 450 MHz.

Built in a sturdy enclosed frame, it can sit on the windowsill of your apartment, dorm room or office, and project your signal out of the building with a gain four times better than your old J-pole! The very high front-to-back ratio of the Ham-Panel 440 minimizes the effects of movement behind the antenna *and* RFI/TVI *and* computer noise in receivers. For more information or to purchase the Ham-Panel 440 ($119.95 plus shipping & handling, and tax if applicable), contact Ant-Panel Products, 530 East Fifth Avenue - Suite 12, Naperville IL 60563. Phone/FAX (630) 778-0793.

I Think They're Onto Me...

CCTV introduces the GBC Colorsentry Model CCD-835C color camera. OK, so you're not James Bond. It's still cool, this inconspicuous (smaller than a pack of cigarettes) 4mm lens color camera. If you ever want to photograph something discreetly, the CCD-835C has a 1/4" sensor, a resolution of 325 lines and a sensitivity of .5 lux. It comes complete with a 12VDC power module and 1/4-20 universal mounting. Other lenses are available—2.5mm wide angle, 6.5mm, 8mm and 12mm—making the CCD-835C camera perfect for any application where size and secrecy are important. For more information, contact CCTV Corp., 280 Huyler Street, South Hackensack NJ 07606; Phone (800) 221-2240 or (201) 495-9595; FAX (201) 489-0111.



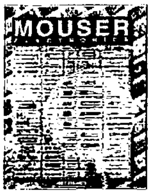
Check Your VSWR!

RF Applications has announced the availability of the Match Alert, designed to offer economical protection for HF transmitting systems. The microprocessor-based Match Alert monitors VSWR and provides a fast visual and electrical alarm if a preset VSWR level is exceeded (eight levels are switch-selectable, and an LED lets you know when RF is detected). The $129.95 you spend now for the Match Alert could save you a lot more, down the road.

For further information, write to: RF Applications, Inc., 9310 Little Mountain Road, Mentor OH 44060. Phone (800) 423-7252 (international (216) 974-1961); FAX (216) 974-9506. Internet http://www.rfapps.com, or E-mail to sales@rfapps.com.

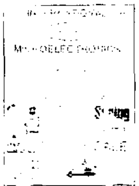
Free RF Neulink Catalog

RF Neulink has issued a new 28-page wireless telemetry catalog featuring crystal-controlled and synthesized wireless transceivers, transmitters and receivers—and the SkyLine RTU, a digital/analog data acquisition and control module. For your free copy, contact RF Industries, Neulink Division, 7610 Miramar Road, San Diego CA 92126. Telephone (800) 233-1728 or (619) 549-6340; FAX (619) 549-6345; or E-mail: 102061.2261 @compuserve.com.



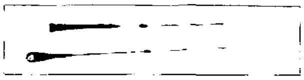
Mouser Releases New Catalog

Mouser's newly updated electronics component catalog offers more than 67,000 products from more than 125 manufacturers. An excellent guide for both buyers and engineers, this catalog provides complete specification drawings and guaranteed up-to-date prices. Mouser also provides same-day shipping on all stocked products. For a free catalog call (800) 992-9943; E-mail catalog@mouser .com; or visit Mouser's Web site at http://www.mouser.com. Nationwide sales: (800) 346-6873; FAX (817) 483-0931.



"You Want It? We Got It!"

Like to pore over small-print parts catalogs looking for the unusual and rare—and finding some real bargains? Get a copy of the International Microelectronics catalog! It's true—they've got it! They specialize in overstock, surplus, and discontinued electronic components, and this may just be the source you've been seeking so you can finish up that project. International Microelectronics, P.O. Box 170415, Arlington TX 76003. Phone (800) 999-0463; FAX (817) 473-0525.



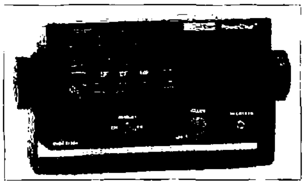
Two New Mobile Antennas from Premier

The 24-inch PNC-2 and its 37-inch sibling PNC-4 are now available from Premier Communications; they're both 2 meter/70 cm and deliver maximum signal gain for their size.

The PNC-2 has 2.1 dB gain on 2 meters, 3 dB gain on 70 cm, and handles 100 watts of power. It is set for near 1:1 SWR at 146.50 MHz and it's quite broadbanded; it also covers 130-165 MHz and 400-480 MHz and works great for receiving to 900 MHz.

The PNC-4 is a higher gain antenna optimized to 2 meter and 70 cm operation. It has 3 dB gain on 2 meters, 5.5 dB gain on 70 cm, handles 100 watts, and includes a tilt feature with locking base. Both models are pretuned and ready to install on mounts, and are sleekly designed in black chrome.

Both models have two-way base fittings that mate with UHF/SO-239 sockets or MNO/Motorola-type mounts. Premier carries mounting accessories for new installations. For more information, contact Premier Communications, 20277 Valley Blvd., Walnut CA 91789. Telephone (800) 666-2654; FAX (909) 869-5710.



Add On A PowerClear

About the size of a paperback book, the PowerClear from SGC can be used with any non-DSP transceiver (HF or VHF/UHF) or other audio device to improve audio quality and noise/interference reduction.

Features include flexible audio input/output connections—audio from transceiver, telephone, scanner, cassette recorder, etc. can benefit from ADP enhancement. The operator has full control of audio filters; push-buttons activate the notch filter as well as noise reduction and SNS. An internal amplifier with front-panel volume control allows room-filling audio even when driven from line-level sources. Lots more neat stuff, too, including all the LEDs to let you watch your tuning.

Contact your SGC dealer for price and availability. Call SGC (800) 259-7331 for the name of your nearest dealer.

Number 44 on your Feedback card

STSPLUS, Version 9615

A satellite tracking program from RPV Astronomy.

Thomas M. Hart AD1B
54 Hermaine Ave.
Dedham MA 02026

Recently, I decided to take a look at software for tracking amateur radio satellites. My expectation was that I might be able to locate some of the more audible space vehicles and listen to their communications. I had visions of tracking the *Mir* space station or the NASA shuttle and hearing QSOs with ground stations. About the last thing I ever expected was to become a satellite chaser and actually make contacts.

A telephone call to the ARRL computer bulletin board system allowed me to download a variety of satellite programs and to try them out for free. This is a software distribution channel called "shareware." Try a program: if you like it, pay the registration fee (this is done on the honor system). If you are interested, the BBS is at (860) 594-0306 and uses standard telecommunications protocols from 1,200 to 28,800 baud.

After testing the various downloads, I decided that the STSPLUS software (released in April 1996) offered the features best for my needs. In fact, it has many neat features that I will probably never use, as well as all of the things that I really want. The program is offered by:

RPV Astronomy
David H. Ransom, Jr.
7130 Avenida Altisima
Rancho Palos Verdes CA
BBS: (310) 541-7299 (2,400-14,400 baud)
Cost: I contributed $20, the suggested amount.

Features

STSPLUS is a DOS program that will operate happily under Windows 3.1 (I have tested this; I have not tested it under Windows 95, but would expect it to work). Installed, the program requires 1.8 megabytes of hard disk space, including a 600 kilobyte manual that can be eliminated to save room. The program recommends an Intel (or compatible) 80386 or higher processor and works best with a math coprocessor. I am not aware of a Macintosh version.

The program setup is quite easy. Load the software into a suitable directory and set the latitude and longitude of primary and, if desired, secondary locations. Set the time, update the Keplerian elements (see below), and away you go on the great satellite chase! The program predicts, lists and shows a graphic of satellite passes by time, azimuth, elevation and range. All of this works on EGA, VGA, SVGA and LCD monitors. Mapping is available in a variety of formats and resolutions. Orthographic (spherical) or rectangular projections are available at the press of a single key. In the orthographic mode, the view may be changed from primary location to secondary location or to satellite-centered. Circles of visibility for the satellite or ground station are available. Zoom options run from 100% to 4,000%. Audible alarms (alerting you to times when the satellite is in range) are user-selectable. NASA ground station locations can be switched on and off the map as desired.

Time options include real time, simulated time and fast time. The simulated time and fast time options allow you to observe the satellite during a particular pass and gauge the possibility of contacting other desired locations. You can specify local or UST, as well as standard or daylight times.

Doppler shift is an important consideration in satellite work. As a satellite approaches, the apparent frequency increases; as it retreats, the apparent frequency decreases. As a practical matter, the ground-based transmission and satellite return will seldom be on the same frequency. Many amateurs use separate transmitters and receivers in full duplex to compensate. Others use software to estimate the up/down differences and compensate manually with a single transceiver. The final ploy is to simply send on the receive frequency and hope the other station is tuning up and down looking for contacts.

"Set the time, update the Keplerian elements, and away you go on the great satellite chase!"

One of the most important features of any program is the documentation. I have never seen a better and more complete manual for any other program. If you decide to print the "doc" file, load the printer and be prepared for a press run of 181 pages. I converted the file to Microsoft Word format and used a number 8 font with two columns per page in order to limit the size to a more modest 40 pages after some judicious editing.

The opening menu offers the following selections:

1. Convert Keplerian data to program file.
2. Read standard Keplerian file for program use.
3. Make pass predictions.
4. Tabulate pass predictions.
5. Set launch time/date.
6. Real time satellite data.
7. Select files/paths.
8. Set time and date.
9. Jump to DOS shell.
10. Set options.
11. Run the program.

How about the bottom line? I give STSPLUS software an "A+" without qualification. It's rare to find a program without those foibles and incongruities that make computer usage a frustrating experience. The graphics are perfectly suitable, menus are intuitive and printer output has clear and concise formatting. After two months of testing, I've found the predictions accurate, and haven't found any problems.

Computer systems do not need to be the latest Pentium running at 200 MHz. A more modest computer can produce the pass predictions in due course. The data can be printed and used to determine when the target is in range.

Footprints are the circles on the ground in line of sight with the satellite. These represent the area covered by the satellite signal at any given time.

Length of pass ranges according to the type of satellite and angles of acquisition. I've been tracking a Low Earth Object (LEO), namely the RS-12 satellite because this operates on Mode K. I have HF gear suitable for satellite work, but no VHF or UHF equipment. I have found passes to range from three to 18 minutes. When the satellite is in range, you have to work fast. The experience is similar to contesting, especially if you wish to make multiple contacts. When the Phase 3-D satellite goes up (next year, possibly), I may be in a position to access a high orbit bird that remains in sight for extended periods.

"I've had the chance to meet a new group of hams from Costa Rica to Scotland and make contacts with them in their homes, cars and campsites."

Approximately 250 SSB and CW contacts have provided 35 confirmed states and several countries. What's better, I've had the chance to meet a new group of hams from Costa Rica to Scotland and make contacts with them in their homes, cars and campsites.

Some info and tips

A few observations on satellite operations may help those who have never used them in the past:

Keplerian elements are factors used to compute the location of satellites. This data is available from the ARRL, AMSAT, the RPV Astronomy BBS (above) and many other sources.

Equipment can be quite simple. I am using Mode K, which is a 15 meter uplink and a 10 meter downlink. A simple transceiver with dual VFOs (a Kenwood 430 in my case) and a modest antenna (G5RV at my house) are all that is needed.

Operational aids come in many forms. I have found that a map of the RS-12 satellite footprint centered on my location is very helpful. My footprint is simply a photocopy of a map of North America trimmed to the appropriate size and marked with 360 degree points. After running STSPLUS predictions, I draw a line tracing the starting and ending points of each pass in order to have a sense of where the bird is at any point in time. I am able to visualize the path to various targets this way without using the computer. The size of any satellite footprint is provided by the STSPLUS program when in operational mode.

Further information on satellites is available from many sources. Numerous books on amateur and weather satellites are in print. Amateur radio periodicals print monthly updates on satellite operations. Finally, AMSAT promotes all aspects of this fascinating activity.

Number 46 on your Feedback card

Ham Television

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bbrown@hiwaay.net

Early in the morning of August 24th, hams, students and lots of vehicles laden with ham equipment began to arrive at a small field next to Purdue University in Lafayette, Indiana. No, this wasn't a delayed Field Day exercise. It was another in a series of WindTrax balloon launches.

The WindTrax program

Back in July of 1988, Bob McAuliffe W9PRD, Bill Brown WB8ELK and Chuck Crist WB9IHS launched Indiana's first high altitude balloon carrying ATV and 2m equipment. The spectacular results of this first effort resulted in a continuing series of flights. Early on, Chuck saw the possibilities that balloon flights could offer for aerospace education. Since a balloon can reach the edge of space very economically, it became practical for students to actually build a simulated satellite and fly it.

Doug Craig, a local teacher in Franklin, Indiana, who taught an aerospace class, teamed up with Chuck to involve his students actively in the development and the flight of a balloon payload. Their first flight in October of 1989 involved nearly 20 students who participated in the launch, flight and recovery of their simulated satellite project. Their satellite package contained TV cameras, voice and TV transmitters, and a radar reflector. The FAA and the Indianapolis air traffic control center were able to track the satellite and reported its location back to the student tracking team.

As a result of this flight, students learned through hands-on participation about satellite communications and problem-solving during a complex project. The project was so successful that the Indiana Department of Education has certified the first Aerospace Technology course in the US.

A series of flights throughout the past two years has involved students from Indiana universities, high schools, middle schools and elementary schools. In 1993 Chuck WB9IHS, along with five others, formed a nonprofit corporation named WindTrax, Inc., to help schools and teachers participate and find resources and funding for these projects.

The Purdue WindTrax system

The basic WindTrax system consists of at least two TV cameras, a voice repeater and GPS tracking. The ATV package for the Purdue flight was built by Terry Hudson KT9V and contained two B/W TV cameras. One camera pointed straight up toward the balloon and the other looked out over the horizon. A small car compass was mounted directly in front of the horizon camera to give the ground observers a direction reference (this worked very well). The Wyman Research TV transmitter put out around 1.5 watts on 4339.25 MHz into a 1/4-wave whip mounted on the bottom of the payload. Control of the camera views and the Elktronics video ID was accomplished via a touch-tone control board and a Standard C508A miniature 2m HT. The large disk sticking off the side of the package provided a way to minimize the tendency of balloon packages to spin wildly (the many holes create drag and help to keep the package from spinning).

Purdue University's payload was coordinated through Ed Delp N9YTE and Dave Filmer WB9QPG. Dave built up an APRS system consisting of a Garmin GPS board, a MIMS packet controller board, and an Agrelo Engineering VHF transmitter. This payload weighed very little due to the small size of the packet controller and 2m transmitter. This payload did not fly due to problems with the GPS receiver.

The crossband voice repeater payload was designed and built by Paul Bohrer W9DUU. With an input on 144.300 MHz, this payload retransmitted on 444.85 MHz (modified Tekk FM transmitter) and 52.525 MHz (converted baby monitor transmitter).

The flight

As the tracking and ground stations were being assembled along the edge of the field, preparations began on the balloon flight train. Roger Grady K9OPO brought out his telescope, complete with a television camera adapter and monitor. During the flight he could see the balloon system clearly, even when it was over 30,000 feet high.

Just before inflating the balloon, a large trailer with lots of small doors on the side arrived at one end of the field. Within minutes a huge commotion distracted us all. Over 650 carrier pigeons had been released; they circled around the field once and headed off towards their homes. It turned out they were racing back to Detroit (220 miles away) at speeds between 40 to 60 mph. Now if only we could make an ATV system that would fit on a pigeon ... what a ride that would be!

"The Indiana Department of Education has certified the first Aerospace Technology course in the US."

Although the wind started kicking up during balloon inflation, the liftoff was smooth. It was a beautiful sight to see the balloon heading up to the edge of space. The video downlink showed panoramas of the Purdue campus, as it drifted off on its journey. The video dropped out shortly after liftoff (it turned out to be an overheated video modulator transistor), but came back as the inside of the package cooled. We were all treated to views of the blackness of space and the curve of the Earth. The car compass in the field of view of the horizon camera worked well and gave us a good idea of where the camera was pointing.

The crossband repeater worked great. Even mobile stations from Pennsylvania could be heard

Photo A. Terry Hudson KT9V prepares the ATV payload for liftoff. (Photos by Bill Brown WB8ELK.)

Photo B. (l to r): Paul Bohrer W9DUU, Victoria Pratt, Terry Hudson KT9V, Mark Garrett KA9SZX, Al Wolfe WB9OIH and Dick KC9AY recover the payload from the middle of a cornfield. (Photo by Bill Brown WB8ELK)

working through the repeater. The 1/4 watt output from this repeater has been heard more than 400 miles away during several recent flights. It also provided a great way for the chase crew to keep in touch as they tracked the balloon's progress.

The chase

Four chase vehicles and one chase plane went after the balloon shortly after launch. Two of the chase crews had either Doppler or left-right DF equipment onboard. One car used a large beam with success.

After the balloon burst (over 100,000 feet up), the package began its parachute ride back to earth. The downlinked video signal gave us some great landmarks. I-74 could be clearly seen during the last couple of minutes before landing.

Paul Bohrer W9DUU and Dick KC9AY were close enough to actually see the parachute as it descended into a corn field. Kim Miles KB9JQO was tracking the ATV signal with a left-right DF box aboard his airplane. Two vertical antennas for the 70 cm band were sitting on the dash of his plane. He could easily track the balloon, just as if he was tracking a VOR airplane beacon. Kim caught up with the payload and circled it as it came in for a landing. Mark Garrett KA9SZX and Al Wolfe WB9OIH were tracking the signals with a large beam and were just a mile west. Terry Hudson KT9V was a mile east at landing. I was tracking the signal with just a two-element quad with my friend Victoria. We all converged on a large farm to ponder the best way into the field.

It turned out that the balloon had landed as far from any road as it possibly could (one of Murphy's Laws for balloons). Not only that, but after tromping through a soybean field for about a mile, it appeared that the payload was on the opposite side of a rusty old fence another 100 yards into a field of very tall corn!

I watched my portable TV set from the soybean field as the rest of the crew headed into the corn. It wasn't too long before I saw a pair of tennis shoes (Mark KA9SZX) walk in front of the camera lens and heard distant shouts of glee! Everything was recovered in great shape, although the chase crew and vehicles were thoroughly coated with dust and pollen.

Future flights

As of the time of this writing, another balloon was flown from Eastern Elementary Middle School in Greentown, Indiana. The crossband repeater was heard as far away as 410 miles by Bob Wilson WA4ZZW in Priceville, Alabama. In two weeks another flight is scheduled to be flown from New Augusta Public Academy of Indianapolis, Indiana. For more information about the WindTrax program and upcoming flight announcements, check the World Wide Web at: http://klingon.cs.iupui.edu/~pacer/new_augusta/windtrax.html. This online site is courtesy of Indiana University, Purdue University at Indianapolis, Dept. of Computer and Information Science. *Thanks to Chuck Crist of WindTrax, Inc., for the above information.*

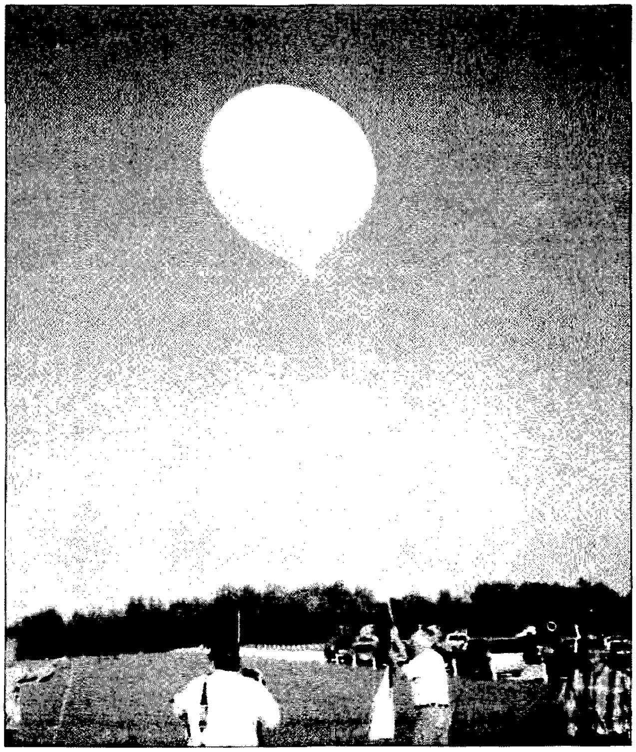


Photo C. Kim Miles KB9JQO tosses the payload into the air as the balloon heads on its way to over 100,000 feet. (Photo by Victoria Pratt)

Number 48 on your Feedback card

Hams on the Radio Information Highway, Part 1

The World Wide Web will help you enjoy ham radio more than ever.

Jack Heller KB7NO
712 Highland Street
Carson City NV 89703

You may smile at the message, "The band sure seems dead to night—maybe all the hams are over on the Internet ... hi." It came across my PACTOR screen the other evening when I asked a fellow ham if he used the Internet. Of course, he meant his remark to be taken as humor. After all, aren't serious hams content to communicate over the airwaves? By airwaves, we must include club meetings and the occasional "hot-air session" at the coffee shop. So, maybe, that isn't so different from the Internet.

But what about the Internet? What can it do for you? Did you know there are over 500 ham radio related sites on the World Wide Web (WWW) of the Internet? I didn't—until I started checking out ham sites a few weeks back. There truly is something for everyone, from the non-ham who would like to know more, to the most advanced DXer, contester or experimenter. Hams the world over are interested in other hams. It happens at clubs, over the air, and now it is fun and easier than ever to exchange information quickly with thousands of polite, friendly and helpful hams on the Internet. For the ham or wannabe ham, the safe, comfortable world behind the keyboard can be ideal for exchanging ideas with other hams willing to share their hard-earned knowledge.

Just for openers: Did you know there is a web page that allows you to access current callsign information? It's http://www.ualr.edu/htbin/callsign.exe. It took me less than 10 seconds to get the data back on my call after entering KB7NO. That is *fast*, especially when compared to the time it takes to use the print version I have on the shelf. Don't let all those long strings of itty-bitty letters intimidate you. You can often access a web site by clicking a hyperlink reference. Then you can save the address in your "bookmark" for an automatic "revisit" another day.

If you use Netscape® (see **Fig. 1**), you can easily find any of hundreds of ham-related web sites and news groups, as well as ham files you can download

> ***"It's obvious why some people are hooked on the Internet."***

from the Internet. The easiest way to enjoy "instant success" is to go to the World Wide Web and put one of the search engines to work. Once you get to the search page, you will find a box to type in the subject you want information about (amateur radio). Click "Search" and you are on your way.

You will also find this includes most of the manufacturers, such as Icom, Kenwood, Yaesu and many others, who provide equipment for our hobby. These commercial folks are doing their best to make your visit to their "virtual store" worthwhile, and some of their bargains are offered only on the web sites.

The real excitement begins when you stop at sites such as the University of Arkansas Little Rock Amateur Radio Club home page where the online callbook referred to above is located. This well-appointed page can also link you to the

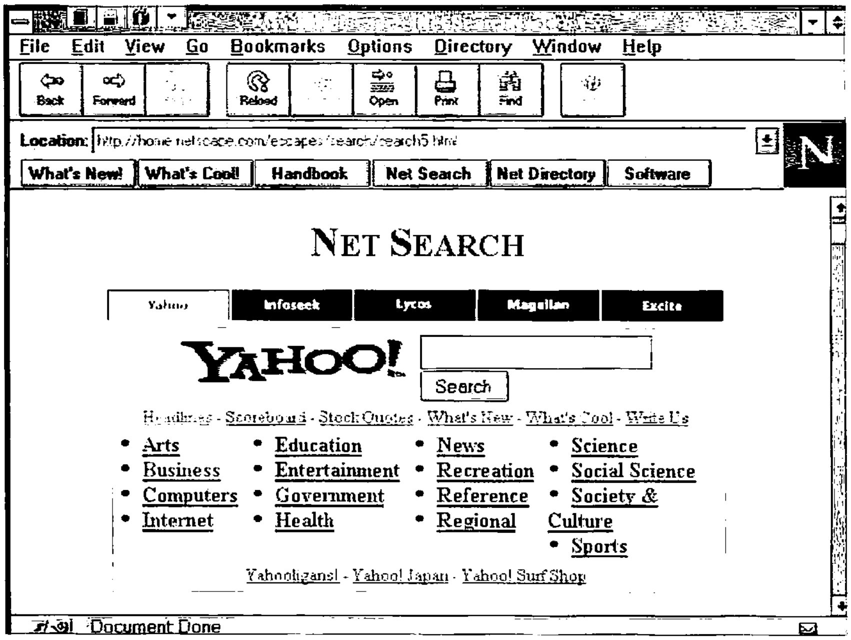


Fig. 1. Netscape features five different search engines. I suggest Yahoo! for simplicity and speed, at http://www.yahoo.com.

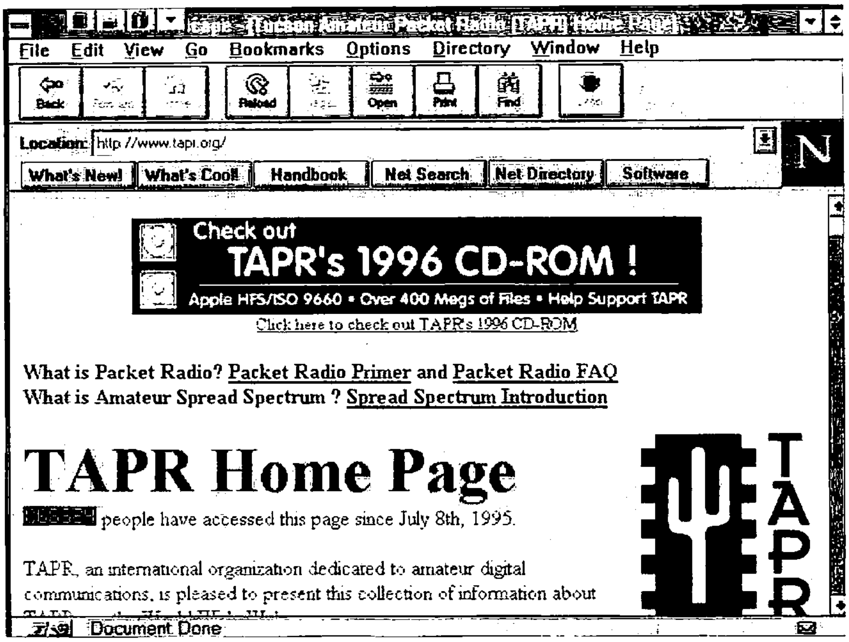


Fig. 2. The Tucson Amateur Packet Radio homepage is an excellent place to get up to speed on packet and all that goes with it, at http://www.tapr.org.

W1AW page, their own amateur station page, *Yahoo!*, FCC Part 97 database, and two great ham general interest sites.

When I first visited this site, I encountered one of the Internet gremlins. Two of the links did not work that day; so many systems are interconnected that occasionally the input acquires a hiccup and a link won't work, but problems of this nature usually heal within a few hours or days. You get used to it (I simply went on to other sites). You can always go back another time. The results will probably be even better when you do return.

Looking further, AMSAT presents its own exciting page (http://www.amsat.org/amsat/AmsatHome.html) where they tell all about their program and how hams are making it possible. There is a display of actual photos of the work as it is being performed on the amateur satellites.

The Tucson Amateur Packet Radio home page (**Fig. 2**) is very well done. This is a "must-see" for anyone with even a fleeting interest, up to and including those deeply involved in digital concepts.

Another great web page you won't want to miss is NØXIC's Amateur Radio Resource (**Fig. 3**). Marc has put an enormous effort into this presentation. You can get information on becoming a ham, find answers on about any ham topic and there are links to many web sites and other web sites. You can easily satisfy your need to read—and then some. On this page, you will see over 75 references with links to other ham-related sites that require only the click of a mouse to provide you with another world of information to absorb.

"Manufacturers want to make your visit to their 'virtual stores' worthwhile, and some bargains are only offered on the websites."

I printed a copy of this web page to keep for reference. On my hard copy, I marked 21 places to visit as time permits. They include many informative sites with extensive information about amateur satellites, solar activity and solar images, antennas, and club web sites.

Marc's page is only one example of what many hams are doing to make traveling the Internet pleasant and informative for the rest of us. There are many more such interesting sites, and the creators are constantly upgrading them to make our surfing ever more productive.

The marvel of the hyperlink makes all this so easy that I can see why folks are hooked on their own niches of the Internet. You look at one of these web pages and find an invitation to click a hyperlink line with the mouse and you are suddenly in another ham area and it may just as easily lead you to another. Before you know it, the XYL is ringing the dinner bell.

All this makes a great tool for you to connect with hams who are helping others in just about every facet of our great hobby. Yes, if you haven't already gone on line with your computer, now is the time. There are a number of hams who check in regularly on this "land-line" based system. (Actually, the Internet doesn't rely solely on phone hookups. If it will make you feel better about participating, there are radio and satellite links discretely working in the system as well.)

Now, I am going to tell you how easy this is to do (if you aren't already doing it). You won't need a degree in computer technology, and you won't even be required to pass a code test. If you have a relatively modern computer such as a Windows-based IBM compatible or a Macintosh, you have most of the equipment covered.

The cost isn't outrageous to add a modem to one of these computers and the software is relatively low-buck. You will spend about $70 to $120 for a good modem. Many new computers are sold with the modem installed. The current standard is rated at 28,800 bits per second (bps). I am still using a 14,400 bps modem which "they" say is barely adequate. It is doing an OK job for me, but if you purchase new, go with 28,800 bps.

The modem is easy to install in the IBM style computer. Just remove a cover at the back of the chassis to expose the end of the slot that makes room for the phone lines and plug it in. Macintosh folks always have an Apple guru lurking nearby for advice, and they assure me Macs are at least as easy to configure as my clunky 486 IBM clone.

Once your modem is installed, you need terminal software to tell the modem to ring a telephone somewhere, and you are nearly ready. Most modems come with a trial package of software to get you going. If you are going to go strictly with a phone connection to the Internet, you will need to find an Internet Service Provider (ISP).

You have several choices when choosing a provider. Some of it depends on where you live and if that

results in long distance charges to connect. You may fare better if you check with one of the major online services such as America Online, CompuServe or Prodigy and take advantage of their Internet access. The rates of the major services are competitive. You just need to find one that is close and has a fairly high-speed connection (minimum 9600 bps).

A good provider will answer your questions and be sure you get going in the right direction. He is likely to have software for little or no cost that will be just the ticket. The current favorite Internet "browser" (terminal program that decodes what's on the Internet and displays it on your monitor) is Netscape and it's free! I am using the latest version, 2.01, that I downloaded over the Internet directly from the company as a 90-day "evaluation" copy. One day, we'll all have to buy the finished product, but for now .... Your Internet provider can tell you how to get your first copy, and how to get the only other piece of software you need; a "dialer." The standard of the industry is Trumpet© and an

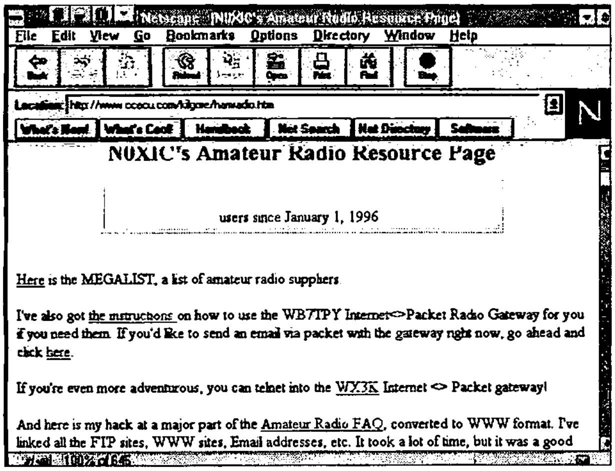


Fig. 3. NØXIC's references touch on nearly every facet of ham radio—a worthwhile visit at http://www.ccecu.com/kilgore/hamradio/htm.

evaluation copy is available that will cost you $25 (money well spent) when you register it within the first month of use. If you don't register, it self-destructs.

If you are using Windows 95©, you can configure that operating system to make the connection for you without using a dialer such as Trumpet. However, it is a little tricky and you will need some specific guidance. Though I haven't made the installation myself, I have the step-by-step instructions from Netscape to do this. I furnished them to a friend who still had to call his ISP to fill in a few blanks left out of the instructions. Now his works faster than mine. I guess that means I must break down and install the Windows 95 someday.

One of the really neat features of the new version of Netscape's search page is the option of most of their search engines to not only perform web searches but to search the newsgroups for material by topic. It all works great and you must be careful—don't get hooked. You could easily run out of time for life's necessities (chasing DX, rag-chewing, repairing your antenna, etc.)

Next month, we will explore Usenet newsgroups.

Never say die

Continued from page 42

You probably saw the TV exposé of what happens when a Wal-Mart® or Sam's® comes to a town. The lower prices soon put all local competing merchants out of business, often leaving main street looking like a ghost town. Then, if the Wal-Mart doesn't make enough profit, it folds up and leaves the people with no place nearby to shop. The local stores don't come back. Most of them had been in business for several generations of family ownership. And who's going to start a clothing or department store in a small town today when a discount monster can open up at any time and wipe everything out?

The next obvious step in the ham field is for the manufacturers to eliminate the no longer needed middlemen by going factory direct. This is what Swan did many years ago. But they got forced out of business by the then still strong dealers who wasted no time in telling any ham customer how rotten the Swan junk was.

Back when I started *73* in 1960 I had over 850 ham stores carrying the magazine. Today there are an estimated 50 ham stores left, and many of those are hurting. I'm sure the retailers who are left really appreciated it when *QST* ran an article on how to whip-saw dealers to get the lowest prices.

With so few dealers, much of their business has to be done by mail order if they are going to survive, which makes it even easier for the major manufacturers to be in direct competition. And since few dealers these days are able to handle repairs ... well, you get the picture. If the dealers are going to survive they'd better organize in some way, otherwise the handwriting is on the wall. Radio Shack®, catering to the no-coders, is skimming the cream, and all it takes is a couple of feet of floor space in their stores. If that.

Snow Job

Art Bell W6OBB called the other day and asked if I would be a guest on his radio talk show again. My last guest shot on his show resulted in several thousand letters and faxes and generated a lot of interest in amateur radio, including a bunch of new *73* subscribers. I also generated a good deal of interest in my list of "books you're crazy if you don't read." The list had 49 books at the time. The list brought in a bunch of letters recommending other books that really should be on the list. I bought 'em and read 'em. In some cases the listeners were right, so I've added the books to my list. It's up to 88 books now, and I've got a stack of over a hundred more recommended books sitting here yet to be read. Some look really interesting, too. Nope, no fiction.

So I said okay, let's do it again. I was on with Art for four hours. I forget what all we talked about, but we started off with amateur radio, with me explaining that as a direct result of my interest in the hobby I've had some amazing adventures and a wonderful career. Imagine, working in your major hobby!

For the first few days after the show I was getting a stack of letters about 18" high every day. Over 4,000 in the first week. Plus my poor fax machine was grinding out faxes day and night. This happened a week before the Dayton HamVention, so I was sure glad I'd decided not to go this year. I've been spending about 18 hours a day opening letters, duplicating my booklets, and then addressing, stuffing and mailing envelopes.

My most popular booklet is the five-buck 28-page recommended book list. It has a discussion of each book. The books cover many aspects of health, education, history, science, etc. Many are books I've reviewed for you in my editorials. Maybe you noticed.

Rich? Why Not?

My next most popular book was the one I wrote as a result of the requests from my first guest shot last November. Art and I had been talking about TVI and I suggested that the best solution was the one I went for—living on a 200-acre farm with no neighbors within a mile. Art pointed out that this takes money. I said that, heck, making money is easy, once you know the secret. Our social and educational systems make sure that 99.9% of us never make much money. I didn't figure it all out until I was 28. By the time I was 30 I'd made my first million. I got off the quiet desperate treadmill to oblivion. I was upset when I discovered that by not knowing the secret I'd wasted over 10 years of my life. Drat!

So I wrote a booklet on "Making Money, A Beginner's Guide." It's selling like crazy. Oddly enough I wrote a very similar book 35 years ago and couldn't sell it to young possible entrepreneurs, even at $1. Now those same people are in their 50s and they're beginning to

Dear Readers,

It's a survey! It's a drawing! Win a prize and money!

73 needs your help! 73 really appreciates your sending your feedback cards to us. Now, we'd like to know something about you and your hamshack.

Return this survey and take part in 73's random drawing of all the survey responses received by December 16th, 1996. The winner will receive $100.00 cash and a Life Subscription to 73 (okay, so you are already a "lifer"...enter anyway and give your "prize" to your grandchild). We'll announce the winner's name in our February '97 issue. So, please answer the questions below on an 8 1/2" x 11" sheet of paper and return them to:

73 Amateur Radio Today
70 Route 202 North
Peterborough NH 03458
Attn: F.I. Marion

FAX at (603) 924-8613 or
E-mail: Design73@aol.com

Be sure to include your name, callsign, address, and phone number. Keep those reader service cards and the feedback cards coming. Good luck!

1.) a. Do you subscribe to *73 Amateur Radio Today*?
b. What do you like most about the magazine?
c. What do you like least about the magazine?
d. If you're not a subscriber, why not?
e. Where did you get this issue?
f. What other radio magazines do you subscribe to?

2.) a. How old are you?
b. How long have you been involved with amateur radio?
c. What encouraged you to become involved with amateur radio?

3.) a. Do you belong to any radio clubs?
b. Which ones?
c. What do you do at meetings?
d. Have you or your club participated in any beneficial projects in your community?
e. Describe.

4.) How many hours per week do you spend on this hobby?

5.) a. Do you ever fill in and return 73's feedback cards?
b. If not, why?

6.) a. Do you send in the reader service cards?
b. Do you contact 73's advertisers because you saw their ad in 73 Magazine?
c. Do you tell them where you saw their ad?
d. Do the advertisers usually respond to your request for information?
e. How many products have you purchased from our advertisers in the last 6 months? 12 months?

7.) a. Do you find 73's product reviews helpful in selecting new equipment?
b. Do you contact any of the companies after reading a review to get more information?

8.) a. Do you read the "New Products" section?
b. Do you ever make purchases based on what you've seen there?

9.) How many "ham" related purchases have you made in the last 6 months? 12 months?

10.) a. Are you planning on making any large purchases in the next six months? If so, what? How much do you plan to spend?
b. If you read reviews of this product, would it influence which brand you would purchase?

11.) Of the major manufacturers, which 3 brands makes up most of your ham equipment?

12.) a. Do you purchase kits?
b. If so, what brands?

13.) Do you enjoy construction articles?

14.) a. Have you been on a DXpedition?
b. When and where did you go?
c. Did you do or see anything worthy of writing an article for 73?

Thank you for participating in this survey, good luck in the drawing.

wise up that there are very not many downsides to having a bunch of money, and surprisingly few benefits to poverty. Worse, they're the ones being downsized as computers and communications technology shrinks the management layers in larger companies. Suddenly they're faced with a need to find a new career, something they've never really considered before. There's just no market for ex-middle managers in their 50s. That's something for anyone still dependent on a paycheck to consider.

Bell's program covers the country pretty well. I've gotten letters from the Virgin Islands, and from every state.

But even with four hours I didn't get to talk about many interesting controversies such as past lives, reincarnation, near death experiences, out of body experiences, UFOs, contactees, Roswell, and stuff like that. Or go into detail on just how crummy our medical and school systems are and what can be done to fix them. How we have one of the most expensive medical systems in the world, and yet we're near the bottom in health. And ditto our school system.

But I did get to talk about the fun of making ham satellite contacts and things more dear to your heart. I talked up new communications modes and the pioneering fun and adventure they provide instead of grinding out routine hello-good-bye, please QSL contacts endlessly for years. Or calling into a roundtable or repeater, the ham version of hanging around the corner.

Adventure lies in wait, tapping timidly on your door. How much do you know about spread-spectrum communications? Well, if you don't, then dammit, learn. And then start writing articles so we can get some other readers fired up. There is no question in my mind that spread-spectrum digital communications is either going to be our main future system for communications, or we'll lose the whole hobby as the FCC sells off our frequencies.

Plan Ahead

Mankind does not have a good record for considering the future, so why should we expect anything but temporary expediency from the FCC? The Commissioners are political people; servants, not savants. They bow to the pressures of immediate money, and who the hell cares about what effect this might have on the 21st century? Or even beyond?

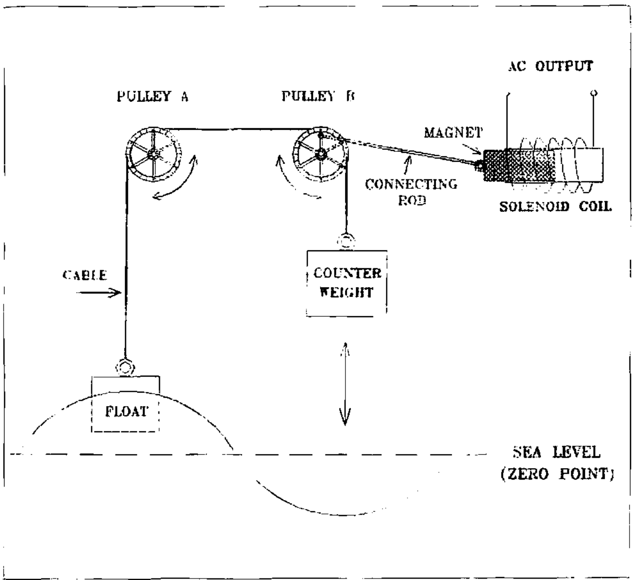
Continued on page 55

Number 53 on your Feedback card

UPDATES

The missing figure in "Free Energy"

Drawing your attention to September's article "The Amateur's Guide to 'Free Energy' Devices," **Fig. 1** on page 10 is actually **Photo A** seen also on page 18. For those who caught that before we did and were wondering how the heck the generator pictured could harness ocean waves, here's what **Fig. 1** really looks like:



Number 54 on your Feedback card

Carr's Corner

Joseph J. Carr K4IPV
P.O. Box 1099
Falls Church VA 22041
E-mail: carrjj@aol.com

AC Power Overseas

You make the big decision: You'll go on a worldwide DXpedition, see the sights, ham from exotic locations, pick up a few souvenirs, and take about a gozillion color pictures. All you need to do is get a passport (takes from three to eight weeks, sooner if you can prove urgency with a ticket that shows an imminent departure date—bring a note from your mommy), stop by a few consular offices to obtain visas (don't want to get arrested at the airport), pack some clothes and the ham rig and take off. Right? Wellllll, maybe not.

There are a number of things that must be tended to before leaving. Not every country is going to let you operate, or, for that matter, even bring radio gear into the country. The ARRL (225 Main Street, Newington, CT 06111; hq@arrl.org) can advise you on reciprocal licensing and other issues relating to hamming in various countries. Some old hands could also tell you about the specifics of each country (bribes? never ... I think they're called "paperwork facilitation fees"). One chap told me that a certain Latin American country almost always imposes a huge import tax on radio gear brought into the country in the cargo hold of the aircraft, packed in factory boxes. On the other hand, if you carry the radio under your arm, and make it look a bit old, a $20 bill to "facilitate paperwork" seems to do the trick. He's done that with a couple rigs, including a TS-440 recently (would you believe it, the guy's a missionary ... *they* don't "facilitate paperwork," do they?).

"Bribes? Never ... I think they're called 'paperwork facilitation fees.'"

Another major issue is the matter of AC power for the rig. Many ham rigs are equipped with AC power mains selector switches on the back of the rig (or of the power supply if it is separate). In other cases, there are taps on the transformer for different voltages. For example, one species of the TS-520 I saw had a 120/240 volt switch on the rear panel. But a service technician showed me something that was not hooked up. The schematic showed several additional primary taps that could accommodate primary voltages of 100 to 380 volts, depending on which was hooked up. It only makes sense. After all, why would the manufacturer make different transformers for different countries when a few taps cover a lot of QTHs?

In some cases, you will need an external transformer adapter for the power supply. Don't rely on those little transformers that run your electric shaver, for they are too low-powered. Isolation transformers come in 1:1 and 2:1 ratios, so they can accommodate a variety of power situations. The most useful of those have a 120 volt AC outlet on one side, and a plug and voltage selector on the other. Transformers of that sort are not rated for power (i.e. watts), but rather are rated for volt-amperes (VA). VA is the same as watts, except for the power factor.

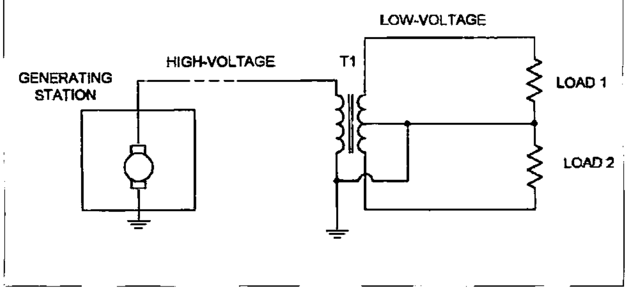


Fig. 1. North American power distribution system.

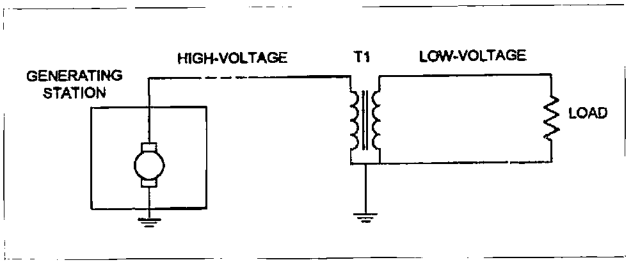


Fig. 2. Alternate power distribution found in some countries.

Power distribution systems

Fig. 1 shows the standard AC power distribution system in North America. The generating station produces high voltage AC power. It is distributed at high voltage so that the current is reduced (for any given wattage), and that makes transmission through lossy transmission lines less of a headache. It will go through a number of step-down transformers, but I've shown only the one outside your house. It will have a high-voltage primary, and a 240 volt center-tapped secondary. The center tap is grounded. If you want a 240 volt outlet, then you take the voltage across the two ends of the transformer. But if you want 120 volts, then you take the voltage from ground to either end. Two "circuits" can be served (shown as LOAD 1 and LOAD 2). Of course, in a real system there are switches, fuses, circuit breakers and a distribution box as well as the transformer shown in **Fig. 1**.

Many overseas locations use the same type of distribution system, although the voltages may be different from those used in the United States and Canada. Other countries use a single secondary distribution system, such as that shown in **Fig. 2**. The voltages available will be listed in the form 120/240, or whatever voltages are actually present. This system is pretty much the same up to the primary of the transformer, but the secondary is not center-tapped. The voltage listed for those countries will be only one level.

Various plugs and sockets are found around the world. **Fig. 3** shows some of the different types of plugs that will be found. You will need to either buy adapters to go from our system to theirs, or buy new plugs when you arrive.

A booklet for you

If you want detailed information about plugs, voltages and so forth, the U.S. Government can supply a little book for $9.95. Ask for *Electric Current Abroad*, publication number PB91-193383. Write to National Technical Information Service, U.S. Department of Commerce, Springfield VA 22161. Call 1-800-553-NTIS, or in the Washington, DC, calling area, 1-703-487-4650.

Connections ...

I can be reached via snail mail at P.O. Box 1099, Falls Church VA 22041, or via Internet E-mail at carrjj@aol.com.

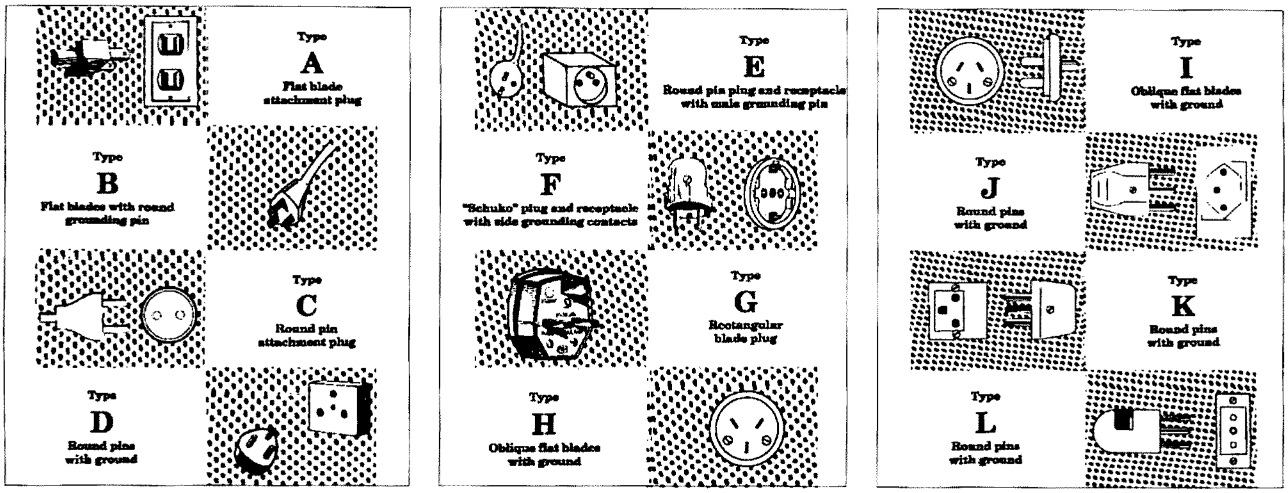


Fig. 3. Plugs and sockets (in domestic and commercial use) found in various countries. (Reprinted from Electric Current Abroad, *with permission of the International Trade Administration.)*

NEVER SAY DIE

Continued from page 53

When America was discovered the Europeans came over, got rid of the Indians, and then started exploiting the land in every way they could. They dug for gold, silver, lead, coal, oil, and so on. They cut down the forests and planted crops. They just about wiped out those annoying buffalo and much of the other wildlife (like wolves). I think there's a small area of virgin forest left someplace in Pennsylvania. Never mind what this cutting of forests has done to our land, water, and the whole ecosystem. If you're interested in the long-term changes cutting down forests makes, you'll want to read *Living Water* by Alexandersson (ISBN 0-946551-1-57-X, 162p, 1995, Gateway Books). He explains why it is impossible to make a Stradivarius violin anymore. The new growth forest trees grow too fast to make the solid kind of wood they had 200 years ago. There *isn't* any more. They're even busy clearcutting the virgin forests of Borneo to build houses in Japan.

We talk about the world's oil supplies maybe lasting another 50 years. Well, we have to make sure people right now have jobs, and who the hell cares about what problems we're leaving for our grandchildren. And their grandchildren. That's fine as long as you refuse to read what is known about reincarnation. Did you know that the Council of Constantinople in 533 AD eliminated the concept of reincarnation from the Christian religion?

Between ham radio, cold fusion, our major social problems, and the weird stuff, I can liven any talk show, so if you know a talk show host, please have him get in touch with me so we can drum up a few more hams. It's Wayne Green, Peterborough NH 03458. I even check Design73@AOL.com now and then.

Not that we can honestly blame the government, nor even the big corporations which run the government, about ignoring the future. After all, most of us are doing the same thing ourselves by smoking, drinking, using drugs, getting fat, and other forms of there-is-no-tomorrow slow suicide.

Prestige, a Zero-Sum Game

Our universities and our scientific elite are powered almost entirely by the prestige game, and the bottom line for the universities and our country is zero. Our scientific elite produce endless scientific papers about minutia, slicing the baloney ever thinner.

If you think I'm exaggerating then you haven't done much work with a college or university. I have, and with several. And you certainly haven't read any books on the state of our colleges today. Like the wonderful book by the president of Hillsdale College, George Roche, *The Fall of the Ivory Tower*. Yes, of course it's on my list of books you're crazy if you don't read.

Okay, so what? So our colleges are turning out mush-headed semi-literate, drive-deprived graduates. And this is the vanguard we're depending on to compete in the 21st century global market?

I tried hard to help Rensselaer Polytechnic Institute pull itself out of its 19th century time warp and leapfrog into the 21st century. I consulted with the faculty and the president of the college. I donated a bundle and became a Patroon. I was put on the Board of Overseers and then ignored (along with the other Overseers). I was enormously honored by being appointed to the RPI Council, where I was again largely ignored. "Just shut up, call the alumni and ask for money." I was named their first Executive In Residence. On the thin positive side, I revamped

Continued on page 76

Number 56 on your Feedback card

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
7462 Lawler Avenue
Niles IL 60714-3108

Cleaning Up Your Act!

Here's another tip for the Alinco DR-1200T 2 meter transceiver, for cleaner sounding transmit audio when using the supplied electret hand mike. Though the particulars will vary, it should be applicable to other radios.

Electret condenser microphone elements are inexpensive and have very "flat" response curves, but they require an external source of low-voltage DC power to operate the built-in FET preamp. An electret element puts out so little energy that preamplification is needed immediately, and an FET preamp is built into the element as an integral part of the tiny package. The external voltage to power the preamp usually comes from the transceiver with which the microphone is being used, although a battery within the mike's case can also be used. When the transceiver supplies the mike power, it usually comes in on one of the unused mike connector pins, and generally from the transceiver's +5 VDC Vcc line. If that line also feeds any digital ICs, and filtering of the Vcc line isn't close to perfect, the +5 VDC line can sometimes introduce noticeable digital noise superimposed on your mike audio.

Listen to your transmitted signal on another receiver—with the CTCSS encoder off and in a quiet room—to see if this might

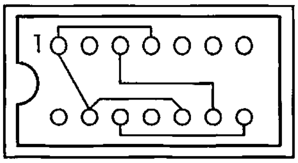


Fig. 1. The 74LS74 is notorious for the number of jumpers needed, and serves as a good example of how Frank KB4ZGC's idea can be implemented to avoid the "under-PC-board jumper jumble."

be true in your case. If anyone has complained about your on-the-air audio quality, make the quick test mentioned above.

If you get digital noise or other unidentifiable pops and clicks from time to time on your transmitted audio, the cure may not be difficult, depending on your transceiver. You can try simply more filtering—right at the mike connector pin that supplies the DC to the mike element, in the form of an additional capacitor from that DC pin to ground (trying different values to see if there's any improvement). If that doesn't work, which is often the case, then it's on to the next step, which is what I did with my own DR-1200T.

Probing around with a little battery-operated, solid-state, high gain audio amplifier (via a .1 µF disc cap), I "listened" to the various DC lines in the DR-1200T. Some points are much noisier than others, some lines very "clean." It's a situation that may be difficult to predict from the schematic alone, but it's a cinch with the little "noise tracer" amplifier! By the way, this idea works in many other troubleshooting areas as well (hum problems, cross-talk, noise spikes, etc. on the DC lines). In my own DR-1200T, I found that the output pin on the 7808, 8 volt regulator (IC-1) sounded very clean, so I changed the DR-1200T's mike voltage source from the +5 VDC Vcc "noisy" line to the +8 VDC "clean" line. In the DR-1200T it's something of a chore, but still doable. The reason is that Alinco uses PC board traces to feed the mike connector, and the connector itself is part of the "display" PC board, so traces must be cut and rerouted. Other radios, with individual "actual wires" being fed to the mike connector, may be easier to convert.

On the rear (foil) side of the display board, two jumpers will need to be added to reroute the +5 VDC line around the mike connector. Since the display board is a double-sided PC board, the opposite component side must also have one trace cut; no jumpers need be added on this side of the board. You can trace the circuit out if you wish, but these steps should effectively isolate pin 5 of the mike connector; now "clean" +8 VDC can be brought up to the connector, via a new "direct" wire, from the +8 VDC regulator mounted on the rear wall of the transceiver's case. The circuit board is crowded, the traces close together, but if you take plenty of time and common care, it should go smoothly.

More

Another side to the "clean DC" issue is obtaining a reasonably noise-free mobile environment. Mobile noise can be that which is only perceived in the mobile's own receiver, and that which may also be impressed upon the mobile's transmitted signal. Both can be problems, in that the solution is often "cut and try."

There are a few things, however, that every good mobile installation should automatically include, whether in a car, motor home, boat or private plane.

First (as touched upon in John Ayers AA1IC's tip in last month's column), is running a separate "clean" battery feed—one that only feeds the ham transceiver—directly from the vehicle's battery. Hopefully, such a "dedicated" feed will be relatively free of switching noises generated by computers, the ignition system, vehicular sensors, etc. The feed should consist of a separately fused battery run made with a gauge of wire heavy enough so that the voltage drop across the wire's resistance is insignificant at full transmitter power drain. Often, this alone will solve many mobile noise problems. But if it doesn't, here's a simple test you can perform to see if the noise is from radiated energy or if it's coming in via the DC power feed. Simply disconnect the radio's antenna. Does the noise disappear? If so, then it's radiated noise being picked up by your antenna; that's generally more difficult to troubleshoot. If it doesn't disappear—or if enough still exists to be a problem—then it's likely to be coming in via the radio's DC power feed.

What if you've run a separate power feed, directly from the battery, of heavy-gauge wire, and a significant amount of noise persists with the antenna removed from the set? You can try shielding the feed cable from the battery to the radio, using the shield and jacket from a length of RG-8 coax from which the center conductor has been removed. It shouldn't be necessary for most installations, but it's worth trying (and inexpensive enough) when the noise is persistent. If shielding the feed cable doesn't do it, then a choke in series with the DC power to the transceiver may help. Parts Express™ (1-800-338-0531) lists commercially-made chokes up to 4.7 mH, made of #14 wire, and exhibiting 0.52 ohm of resistance or less. They also carry computer grade very high capacitance power capacitors (one farad!) that will not only help filter noise, but will also smooth out any voltage variations from peak surges during SSB voice operation—the next best thing to having the battery itself right behind the radio.

If most of the noise you hear in your mobile transceiver is coming in via the antenna, then you'll have to settle in for some real hunting. Ignition system wiring is usually the best place to begin, either installing new resistance ignition wires or going full tilt into a specially-made shielded system; it mainly depends upon how much noise you can comfortably live with. Today's cars also can have one or more computers controlling vehicular functions. Computers generate square waves by the score, and square waves have lots and lots of harmonics; many of these harmonics will appear within the ham bands. Some of the slip-on, thread-through, clamp-over ferrites available today will tame computer generated noise and harmonics without having the slightest ill effect on the computer control system (they only absorb unwanted RF energy). Where they're needed and how many

will be necessary is the "cut and try" part mentioned earlier; it's anyone's guess. Usually, it's best to start at the computer's input and output leads, installing the ferrite cores as close as possible to the shielded computer case itself. From there, it's the sensors on the various parts of the engine that can be given attention, again, as close as possible to the sensor body itself. A shop manual for the vehicle is almost a must at this point. Avoid any bypassing that requires direct electrical contact with the vehicle's electronics; try to stick to non-invasive ferrite absorptive devices or you'll run the risk of compromising your vehicle's control circuitry. Perhaps most importantly, take your time and attack the problem systematically and in small chunks, and thoroughly check out each step you make.

A spicy DIP chip

From J. Frank Brumbaugh KB4ZGC/W4LJD: "I've found this wiring technique to be helpful at times, so I'm passing it on to others who may want to try it. Sometimes Dual Inline Pin (DIP) chips (particularly those in the 7400 family or even the venerable NE-555) require a number of jumper connections among several of their pins to make everything operate correctly. This can result in a jumble of wires or a complicated PC board trace layout in order to accomplish the task. But here's another approach: Carefully solder very fine wires—taken from an untwisted short length of ordinary stranded hookup wire—and make some of those jumper connections right on the bottom of the chip itself. Take care to avoid any shorts, and make the connections high on the IC's "legs," but prewiring some chips like this can save a lot of underboard crosswiring later on. This jumper prewiring can be done on the IC sockets instead, before installation, if your project uses sockets instead of the chips themselves soldered directly to the board. Even if it isn't practical to prewire every jumper needed, the more you can eliminate using this technique, the neater the finished board will appear. Take a look at **Fig. 1** for a couple examples of this technique."

Moderator's note: Frank has a clever idea here; it might also be a good idea to note on the project's schematic which jumpers are hidden, perhaps showing them in dotted outline.

Never assume

Last fall I made a "lights on" alarm (a buzzer sounds when the lights are left on without the engine running) for one of my cars that was missing this feature from the factory. The circuit worked like a charm on the bench and ditto when I installed it in my car. Then the cold weather came. When the temperature dropped below freezing, the circuit still worked, but the buzzer would sound for a few seconds (even when it wasn't supposed to, that is) when the lights were on but the car *was* running. The colder it became outside, the longer the circuit would take to operate correctly. My wife, Sue KA9UCK, is very patient, but it was even getting to *her*!

The problem turned out to be in the relay I had chosen to key the buzzer on and off; a small, sealed, good-quality relay, but it was also very temperature-sensitive. Apparently, the contact arms in it deformed enough in the sub-freezing temperatures to make contact when they shouldn't have, but after heating up just a bit (from current flowing through its coil), the relay operated correctly. I thoroughly tested the replacement relay in my lights-on circuit for temperature sensitivity (by putting it in the freezer for a while) before committing it to the underdash of my car again! Case closed, lesson learned.

We've all run into these problems with equipment that doesn't operate as expected under all extremes of temperature, and it might be a worthwhile effort if you were to jot down some of the more interesting ones you've encountered and I'll include them in the column at some point in the future.

Cold testing a piece of mobile gear is relatively easy; just put it in the freezer for a while. Heat testing is a bit more tricky. The inside of a closed vehicle can reach very high temperatures during the summer months, but testing for extreme heat—by putting the item into an oven—is often dangerous. You don't want to damage your gear with the test! Has anyone devised a reasonably safe heat-test setup, for subjecting mobile ham equipment to summer heat extremes, without too great a risk of permanent damage? You folks in the desert areas should be experts on this one!

Mood lighting

From R. Gary Bartlett VE1RGB: "To me, there is something very calming and perhaps a bit romantic (in the old-fashioned sense of the word) about a ham radio station that makes use of the built-in panel and edge lighting that comes fitted in most ham gear as the primary radio room lighting. It's sometimes necessary to supplement the equipment lamps with some sort of external spot lighting to illuminate a work surface or control panel, but the use of dimmer, rather than brighter, lighting is often a better choice. Having spent some time as an electronics systems operator on a Canadian military subhunter aircraft, often at night, I suppose that I feel most comfortable under the dim light of an operations area, but I've a hunch that many other hams feel the same way. I still enjoy listening on 3.4793 kHz, late in the evening, as the Gander and Shanwick Oceanic Air Traffic Controllers are trading position reports and vectoring their flights across the Atlantic. I try forming a mental picture of where all of those airplanes are, and what they're doing, where they're going and the many countries and companies they represent.

"How can you replicate this mood in your own shack? In our aircraft, we used what was known as a Grimes light, which had a selectable clear and red front lens. It also had a dimming pot and a focusing adjustment. It came with a helical coil cord (like a telephone handset cord) and a quick-disconnect mount, so the light could be removed for viewing some deep, dark recess if needed. In an aircraft, that's usually down

Cable	---------- Frequency in MHZ ----------						
RG/U Type	10	50	100	200	400	1000	3000
6A	0.04	1.90	2.70	4.10	5.90	9.80	23.00
8, 8A, 213	0.551	.30	1.90	2.70	4.10	8.00	16.00
Belden 9913	0.41	.64	1.00	1.60	2.50	4.50	**
Belden 9914	**	1.10	1.60	2.40	3.50	6.00	**
Belden 9888	0.60	1.20	1.70	2.70	4.20	7.80	14.20
Belden 8214	0.60	1.20	1.70	2.70	4.20	7.70	14.20
8X	1.10	2.50	3.70	5.40	8.00	13.50	26.00
9, 9A, 9B, 214	0.66	1.50	2.30	3.30	5.00	8.80	18.00
11, 11A	0.66	1.60	2.30	3.30	4.80	7.80	16.50
14, 14A, 217	0.41	1.00	1.40	2.00	3.10	5.50	12.40
218, 219	0.24	0.62	0.95	1.50	2.40	4.40	9.50
Belden 9915	**	0.60	0.80	1.20	1.90	3.50	**
34, 34B	0.32	0.85	1.40	2.10	3.30	5.80	16.00
55B, 223	1.20	3.20	4.80	7.00	10.00	16.50	30.50
58	1.25	3.15	4.60	6.90	10.50	17.50	37.50
58A, 58C	1.40	3.30	4.90	7.40	12.00	24.00	54.00
59, 59B	1.10	2.40	3.40	4.90	7.00	12.00	26.50
62, 62A	0.85	1.90	2.70	3.80	5.30	8.70	8.50

**** No data available**

Table 1. Transmission line loss table for coaxial line (all values are in dB of loss per 100 feet).

near your left foot, where a dropped pencil could easily jam the mike foot switch. If you have any military surplus stores in your area, it might be worth checking with them to see if they have anything resembling what I've just described. You might also peruse any RV or camper supply catalogs, and/or dealers in your area, since lights of a similar type can sometimes be found in recreational vehicles. Even if you can't locate the exact Grimes light, you might be able to modify a light that is readily available, putting a little of your ham ingenuity to work.

"Try to stick to 12 or 24 volt lighting if you can; it's much safer and easier to use than the much higher line voltage systems. A husky 12 volt transformer, properly fused, is all that's need for an AC low-voltage lighting setup, or your station's 12 volt DC power supply can be used to power some lamps, as long as the supply's current limitations and adequate fusing precautions are observed.

"Dimming the lamps on an AC system requires a rheostat capable of dissipating the correct amount of wattage, whereas a DC system is able to use some of the modern adjustable regulator chips and a simple pot to vary the light output from your low-voltage lamps. An LM-317T is a good one to look into for this purpose (see the drawing in **Fig. 2**).

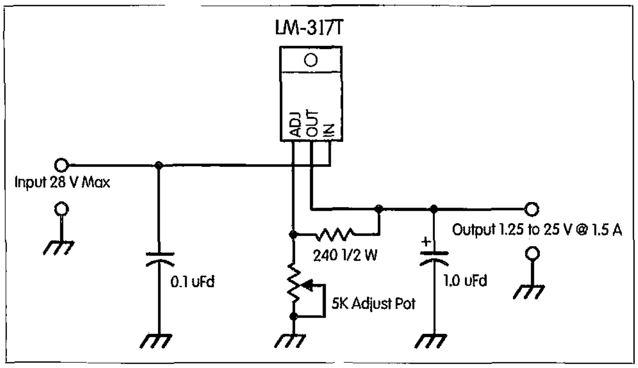


Fig. 2. A simple DC control circuit for use with the low voltage station lighting fixtures described in the text.

"External wiring to the lamp fixtures themselves should match the fuse rating and current drain of each lamp in a leg, and the use of insulated and adequately marked terminal strips makes changing or expanding the system a breeze. Low voltage wiring is much easier to work with than its line voltage counterpart, but care still must be exercised to ensure that all wiring and connections are safe and low resistance. Keeping an up-to-date diagram is desirable and not at all difficult to maintain.

By the way, if you happen to run across some particularly good hardware (fixtures, connectors, extensions, etc.) in implementing this idea, please send them to this column's moderator so that we can all share in your discovery."

Super table

From John McDermott N4YIC: "Here's a reference table of popular coaxial cable line-loss data that you can add to your 'Ham To Ham' pinups! It's certainly not original, but it does provide a fair amount of information in one easily posted piece (see **Table 1**). It lists 32 coaxial cables, along with the normal loss data, from 10 MHz all the way to 3,000 MHz (3 GHz) in an easy-to-read format. I hope it's as useful to others as it has been in my ham station."

A charge slip

Here's a tip for those of you who might own the Yaesu FT-209RH or FT-709RH handheld transceivers specifically, but may apply to other models of handhelds as well.

There are usually two choices for recharging a handheld's battery pack: 1) using the optional drop-in charging stand via the charging contacts on the bottom of the battery pack, or 2) charging the pack with the small wall-cube transformer/rectifier via a little charging jack on the bottom or back of the pack. But wait, here's a third alternative—one that allows you to customize a bit.

The Yaesu FT-209RH uses a "slip-on" battery pack, slipping on from the side of the transceiver, and then locking into place (many others use a similar scheme). My wife and I have two of the Yaesu handhelds, and a couple of the FBA-5 alkaline cell cases too. These are the battery cases made by Yaesu to house disposable alkaline cells, but instead, I've opted to install AA NiCd rechargeables into the FBA-5. This lets me put in new NiCds (or disposable alkalines) any time I wish (ever try to open a "normal" sealed NiCd pack?). The downside is that the FBA-5 doesn't have the familiar charging contacts on the bottom, not being meant to house rechargeables and also so that the user doesn't accidentally drop it into a desk charger with non-rechargeable

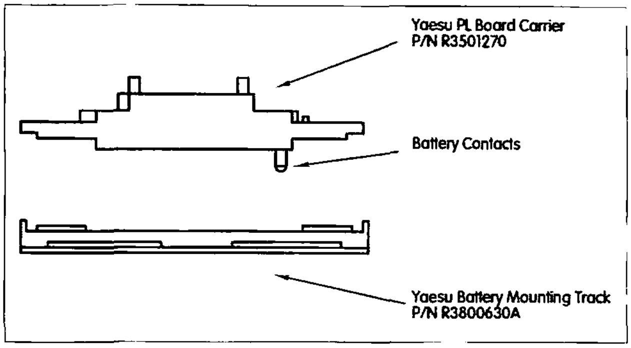


Fig. 3 . Side view of the Yaesu parts needed to make the slip-on charging adapter described in the text.

alkaline cells installed. In order to use NiCds with it, the cells must be physically removed each time recharging is needed—not the handiest of methods.

I wrote to Yaesu's Parts Department and inquired about the possibility of purchasing the battery mounting track and the battery contact plate assembly for the FT-209RH. These are the two pieces that are normally mounted on the bottom of the handheld itself for holding the battery pack in place and to make electrical contact with the pack's output pins. My reasoning was that if I had these two essential parts, I could build a "slip-on" charger housing for my FBA-5 packs, making recharging them a snap (pun intended). Yaesu quoted a very affordable price for the two parts that I needed (their R3800630A and R3501270), which are shown in **Fig. 3**, so I went ahead and ordered them, completing the job with the addition of the simple input jack and charge indicator circuit shown in **Fig. 4**. I'm now able to use the standard Yaesu NC-18B wall cube, along with the new slip-on adapter, for charging the NiCds in my FBA-5 packs, while the LED "continuity" indicator shows indication that the batteries are charging. Overall, a nice accessory to the battery lineup for these handheld transceivers. Of course, the slip-on charger can also be used with the normal non-openable NiCd packs too, providing you with a low-profile travel option.

Gobs of mods

More on the topic of equipment modifications: There are a number of BBSs (bulletin board systems) around the country with copious quantities of interesting modification files for commercially made ham equipment, all ready for downloading. And you don't necessarily have to have a packet station to access these files, though many full service packet BBSs also support equipment modification file downloads. But if you're not yet into packet, all that you really need is a computer with a fairly modern telephone modem and a terminal program that permits uploading and downloading of files. With just that minimum, you can make contact with many amateur radio

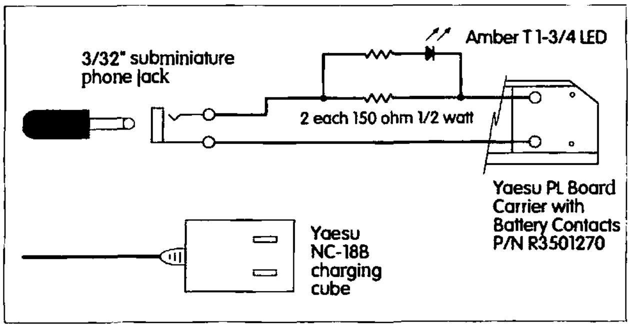


Fig. 4. Schematic diagram of the slip-on FT-209RH charging adapter described in the text.

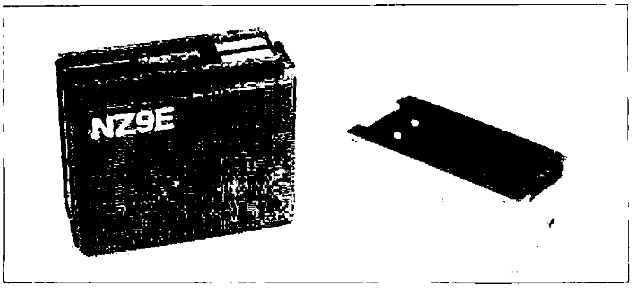


Photo A. *The Yaesu FBA-5 battery pack is shown on the left, the slip-on charging adapter on the right.*

oriented telephone BBSs who welcome ham callers from outside the group of normal users. Check around with local club members, or on your local 2 meter repeater, to find out the phone number of the popular ham telephone BBSs in your area.

One system that I've explored is run by Bill Cohn N9MHT in Schaumburg, Illinois, and operates under the name "The Precision Board." Bill encourages any ham, from anywhere, to call his system at (847) 985-9544, 24 hours a day. When you first sign on, you'll be guided through a few easy-to-answer questions, just to get acquainted. Then, as with many such telephone BBSs, you can quickly download Bill's ALLFILES.ZIP file, sign off, unzip the downloaded file, then browse through the listing offline, to see exactly what specific program files might be of interest to you (the shareware file for unzipping the ZIP file is even available if you don't already have it). You can then call back later to download just those files of specific interest (many are in the zipped format), keeping your telephone charges to a minimum and not occupying the board any longer than needed. The Precision Board is affiliated with the Arlington Communications League (ACL), a suburban Chicago ham radio club, and has hundreds and hundreds of files (programs) dealing with amateur radio, as well as general computing utilities and games. Some of the programs are Freeware (no strings attached), others are Shareware (where the user is encouraged to pay for the use of the program after a free trial period, if you like the program and plan to use it regularly).

It's also a good idea not to just "take" from any BBS, but also to "give" a bit back, in the form of uploading interesting programs that you might have that are also of a Freeware or Shareware nature; don't upload commercially purchased software that isn't intended for secondary users. Like a repeater system that you regularly chat on, a telephone BBS SYSOP can always use an extra dollar or two to help with line charges, equipment operating costs and system upgrades.

Remember, these are volunteers who've put up their own gear for our benefit—don't be a rude "guest" in their electronic den. The same courtesy should apply to sysops within the HF/VHF/UHF amateur digital network as well. They're giving their time, energy and equipment for our convenience, in the traditional ham not-for-profit spirit.

Getting wired

From Mike Hall KE4GBE: "Next time you attend a hamfest or computerfest, keep an eye out for someone selling multicolored computer ribbon cabling; it makes great hookup wire for general electronic project construction use. The multicolored ribbon is much simpler to identify, but even the all-gray ribbon cables can be utilized if you mark both ends of the individual wires with tiny dots (1, 2, 3, 4, etc. dots) using a black fine-point felt-tipped marker pen. The flat computer ribbon cable I'm referring to is generally very good quality, stranded, easy to strip and tin, and will make your home-brew projects look much more professional. There is naturally some inter-wire capacitance, but it usually won't have any serious drawbacks in non-critical circuits. I've also seen twisted-pair computer interconnect ribbons that have automatic resistance to inductive coupling from the outside due to their twisted format.

"I'm sure that I'm not the first to 'discover' this tip—even Heathkit used sections of ribbon cables for some of the interchassis wiring in their kit designs—but I simply thought that I'd mention it again in case it's been forgotten or overlooked by some."

Moderator's note: Good suggestion, Mike. Of course the multicolored ribbon cable can also be separated into individual colors for use as regular single-circuit hookup wire when distinctive colors will be helpful in troubleshooting later on. It's a good way to collect a wide variety of short hookup wires of every color imaginable without having to buy long reels of each color.

That wraps up another month of "Ham To Ham." As you've no doubt noticed, I'm still using too many of my own ideas and suggestions in the column—I need more input from all of you if we're to keep on exchanging ideas each month through the pages of *73*. I've mentioned it before, and it's true: This is your chance to express some of the neat and interesting ideas, solutions, tips or suggestions that you've found handy in your ham radio career. Jot them down and send 'em on to me at the address in the above this column—there's a very good chance you'll see them in print here in one of the future issues. You needn't be an "old-timer" to have had worthwhile experiences; I've received a number of good ideas from relative newcomers to our hobby. Often techniques that can apply to ham radio are picked up from your professional experiences on the job, or sometimes they're just inspirational flashes that come when walking through a store or thumbing through a catalog and seeing something that has "good application for the ham shack" written all over it. Amateur radio touches on so many other areas of life's experiences: outdoor structural and wiring techniques, indoor shack and workshop ideas, computer conveniences, test equipment shortcuts, and on and on. Whatever you've experienced that you believe would be helpful to others is fair game; send it in and let me see what you've thought of. I'll be sitting out by the mailbox, and it's kind of cold this time of year, so don't let me down!

And as always, many thanks to those who've contributed to this month's column:

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Please send all correspondence relating to this column to *73's* Ham To Ham Column, c/o Dave Miller NZ9E, 7462 Lawler Avenue, Niles IL 60714-3108, USA. All contributions used in this column will be reimbursed by a contributor's fee of $10, which includes its exclusive use by *73*. We will attempt to respond to all legitimate contributors' ideas in a timely manner, but be sure to send all specific questions on any particular tip to the originator of the idea, not to this column's moderator nor to *73*.

HOMING IN

Radio Direction Finding

Joe Moell P.E. KØOV
PO Box 2508
Fullerton, CA 92837

Buckeyes vs. Wolverines

Football season is in full swing and Thanksgiving will soon be here. Unless you live in the Southern Hemisphere, you're in for some colder temperatures and shorter hours of daylight. Will that bring a halt to hidden transmitter hunting in your area? T-hunters in Florida and Southern California have relatively good weather all year long, but you have to be more hardy to go on radio direction finding (RDF) contests in Midwestern states.

Weather doesn't deter the intrepid transmitter trackers of southeast Michigan and northwest Ohio, where "foxhunting" is what they call it. The Toledo Radio Amateur Club holds a mobile hunt each month. "The fox can be anywhere within a 20-mile radius of the University of Toledo," says Vince Vasselo KB8TEP. "All he has to do is get a signal into the repeater. He must either transmit on the repeater input or tell the hunters what frequency the hidden beacon is on. It isn't specified how often he has to transmit; we try to keep it at least every minute or so. Intermittent signals like that tend to encourage people to use their maps. The first finder wins the hunt. Once everyone comes in, we have a drawing for who will be the fox the next month."

Another fan of traditional find-the-foxbox hunts like this is Mark Drolias N8IQX of Dearborn, a suburb of Detroit. "We have had many cleverly disguised beacon hunts," he says. "Guys have built camouflage electrical utility boxes and hung them on telephone poles, along with conduit cut for the right frequency and wires dangling to make it look like it belonged there. One hooked a windshield wiper motor up to a beam and set it on a tripod in a bunch of weeds, with the beam sweeping back and forth as it transmitted."

Lately, a different type of hunt is gaining popularity in the Motor City area. "We changed our hunting strategy within the last year to keep the hunts moving and to get more in," says Steve Sable N8NYU from Maybee, Michigan. "We now have 'tag' hunts on Saturday nights. The first fox takes off from the starting point in his car and has a half hour to find a good place to hide. He must stay with the vehicle. Once he gets stationed and starts to transmit, we have just a half hour to find him. The first person who finds the fox has a half hour from that point to go find his own place to hide, while the rest of the hunters continue searching for the first one. Once fox #2's half hour is up, his hunt starts, whether everybody has found the first one or not. This goes on for four hours and we usually get in six hunts."

Steve's group, the Radio Active Communications Club, holds tag hunts on the second Saturday of the month, while the Maumee Valley Monitoring Association of Ohio holds tag hunts on the fourth Saturday night. It's about 50 miles from Detroit to Toledo, so it has become a tradition for Detroit area hunters to go to Toledo hunts and vice versa, just like the age-old football migrations. "We get four or five teams on a low day, up to 15 on a good day," says N8IQX. "When my wife and I go down to hunt in Ohio, we don't get back until 1 or 2 a.m., but we work afternoons so it's OK. It's fun, but lots of wear on tires."

Mark prefers the format of tag hunts. "The fox can use any power or polarization," he says. "He can transmit a little or a lot, with any on/off timing. When he sees people in the area, he can stop transmitting for a while if he wants. After the last hunt of the evening, we meet up for some food. Tag hunts are good because a beginner can come out without knowing anything about fox-hunting, and by the end of the night have found several foxes and gotten a good grasp of it. On the other hand, with a beacon hunt, it's over once you find it and you have to wait a month before you can come out and hunt again."

"You have to transmit from your car, but if you throw a tent over it to hide it, that's legal," KB8TEP adds. "We want everyone to stay in their cars because it's safer. If people come out to ride along, we make them handle the gear. Some really take to it.

"Usually our hunts are on 146.565 MHz simplex," Vince continues. "Occasionally, we throw in one or two hunts on one of the 440 MHz repeaters. Some 70 cm repeater owners are real happy that we are interested in doing some hunting on that band. Another time, for a change of pace, the target was mobile and everybody at the start was told to team up and work together to catch him, instead of competing."

Whereas law enforcement personnel are used to seeing vehicles with strange antennas here in Southern California, Midwestern officers are more curious and suspicious. N8NYU says, "Whenever we hide in a city, we try to notify the police department two weeks in advance. People think we're hunting UFOs or seeking signals from burglar alarms, so they call the authorities. A lot of times, we get pulled over and questioned. On our last hunt, the guy who was the fox got stopped. They said they were going to confiscate all his equipment because he had a scanner in his vehicle. We all quickly converged and showed them the scanner laws for Michigan. That got him off."

"People think we're hunting UFOs."

Quads vs. yagis

Expect to see a variety of RDF gear if you go T-hunting in the Toledo/Detroit area. Steve says, "When I started hunting about five years ago, our antennas consisted mainly of PVC pipe frames with copper piping for elements. They were hand-held antennas; we would stop alongside the road to get a fix and then continue on. With time, we graduated to 2- or 4-element cubical quads with active or step attenuators. Quads were made of PVC pipe booms with Fiberglas™ spreaders and telephone wire elements. Then we began to mount these antennas so we would not have to exit the vehicle. Some made mounts to go through sun roofs, but most made brackets to mount the mast through the passenger window."

Steve and his hunting partner, Chris Theisen KK8K, use a Cubex 4-element quad. "We tried a through-the-window mount and that worked, but rainy and windy weather caused problems," says Steve. "Some of our runs to the fox were made at a little above normal speeds, making it difficult to hold onto the assembly. We once snagged the quad on a low hanging branch, which almost lifted Chris from the seat as he hung onto the mast for dear life. That's when I decided a change was in order.

"I built a wooden holder for my truck bed (**Photo A**). A Ford windshield wiper motor is mounted in the bottom center of the frame (**Photo B**). In the center of the crossboard is a bearing around the mast. We found that without it, there was too much binding of wood rubbing against wood. To show beam heading, I drilled a hole all the way through the mast about six inches above the bearing and inserted a clear plastic tube and a lamp, which connects to a 9 volt battery for lighting at night."

Steve controls the motor with a left-right toggle switch in a home-brew box inside the cab. "We found that applying the full 12 volts turns the antenna too fast for tracking," he says. "To drop the voltage and slow the turning,

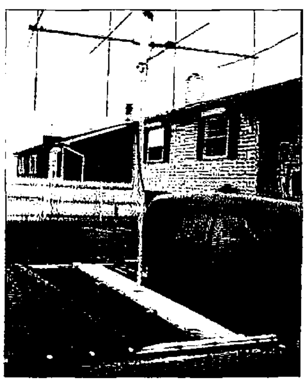

Photo A. N8NYU's motorized quad mounts into the bed of his Chevy pickup with C-clamps. (Photo by Steve Sable N8NYU)

I added a small toggle switch and a series 4.5 ohm 10 watt resistor. Both speeds are useful; high is for checking if the fox signal is 180 degrees out and then low speed is used once you're on the track of the fox signal. With this system, weather is no longer a factor."

Of course N8NYU's setup is a head-turner as well as a beam-turner. "Every time we're in traffic and people pull up next to us, we just sit there straight-faced and sweep the thing back and forth," he says. "Usually, they are still sitting at the light when we take off. If folks have enough courage to inquire, they want to know, 'You guys from the cable company?'"

According to KB8TEP, most Detroit area T-hunters use vertically-polarized quads, while Toledo hunters prefer horizontally-polarized yagis. Vince uses a 3-element yagi, about three feet above the roof. "I seem to have no trouble with cross-polarized signals, even in downtown Toledo," he says. "I guess I am used to them and know what to expect."

Lately, a few hunters in both contingents are trying Doppler RDF sets. When the fox signal is vertically polarized and strong reflected signals are not present, a Doppler does well. "It's all flat out here," Vince says. "So when you are mobile, the Doppler leads you right to it. At the last hunt the first, second, and third place teams were Doppler hunters."

But others disagree, saying that there are enough reflections (multipath) to cause grief to Doppler hunters in many locations, especially if the signal source is horizontally polarized, as it can be in the Toledo hunts. "The Dopplers still find the transmitter," says N8IQX. "But they have not come in first on hunts like that. Users can tell when it's horizontal, they say the signal is more 'wavy' sounding."

When you hunt with the Doppler, you lose that feel for how far away you are," KB8TEP adds. "I compensate for that by keeping an extra receiver with the antenna off in the car to tell when I get close. It helps, because sometimes you go another block and it goes away, so you know you went too far. Some of the guys feel they have some other tricks that will mess up the Dopplers. It will be interesting to find out if they do or not when they get to be the fox."

Jammers beware

Training and practice from the friendly RDF contests are helping keep the air waves in both cities clean. KB8TEP says that Toledo hams have established an interference committee through ARRL, but most of the QRM they have found has been accidental. "I have gone after two stuck transmitters," Vince says. "One fellow had been talking to someone in his shack and set his clipboard down. It keyed the mike of his HT connected to his antenna. I happened to notice the dead carrier, called up Tony Everhardt N8WAC and we went out. My car was in the shop that night so I had to do it with my wife's car and a handie-talkie. We triangulated, found the house, checked the front and behind, and saw the antenna up there, but we didn't know who it was. We ended up with three hams at the scene, so one stayed out on the road and two of us walked up to the door. It turned out to be a ham and he thanked us profusely.

"Another time, someone keyed down solid on a packet frequency," Vince continues. "I got a call from the BBS sysop and we tracked it to a house. We had four cars parked across the street and a woman walked out. We asked if there was an amateur radio set in the house and she said her son was a ham. Then she went back and as we were listening, we heard a jumble of things being moved around and wires being pulled, then the signal quit."

N8IQX is the ARRL Official Observer Coordinator for Michigan, where malicious activities are more common. He says, "Every time I have done a talk at a club, I tell them that if they have a foxhunt group on their repeater, they will have the quietest repeater in town.

"When we first put our RDF crew together, we tracked someone who was jamming the weather net," Mark recalls. "And last year we may have caught a security guard at a retail outlet. A lot of jamming was going on and we got a heading into this parking lot. We saw the guard look at us, then everything stopped and we never heard it again.

"A police department about 50 miles west of Detroit lost a handheld two years ago. Then someone began jamming a paramedic frequency, starting every evening after school. A friend of mine got wind of it and we went out. By nightfall, we had determined which part of the city it was in. A few people returned the next day and zeroed in on the house. The police realized at this point who it was, a problem kid. They went to talk to his father at work and the dad said, 'Let's go home and look.' They found the unit in the house, along with a bunch of stolen cellular phones. The neat thing was that the battery was dying on the handheld, but we were still able to get enough signal to pin it down to the house."

Not only do the Buckeye and Wolverine T-hunt groups like to have joint hunts, they want to hunt over a wider area together. According to N8IQX, "At least once a year we would like to do an all-day hunt for the entire Midwest. Beacons would be hidden around a large area, both metropolitan territory and some woods. We want to promote it enough to get hunters from Michigan, Ohio, Indiana, Illinois, Wisconsin, and Kentucky."

The first attempt at such a wide area hunt took place this spring. N8IQX says they picked the last weekend of April, which had been the weekend of the Dayton HamVention in years past. He would like to make it an annual event on that weekend, now that the HamVention has moved to mid-May. KB8TEP enjoyed that hunt. "We had a couple fixed beacons and then we went into tag hunts after that," he says. "It went really well, though we didn't have many people from outside our area."

You, too?

This column begins the ninth year of "Homing In" in *73 Magazine*. There has been no shortage of things to cover in the world of RDF during that time. More and more readers are discovering the fun of both mobile T-hunting and international-style radio-orienteering. Hams are increasing the use of RDF skills for public service and for self-policing.

There is a good chance that a club near you is now holding hunts and you could be involved. Check the "Homing In" site on the World Wide Web for lots of local T-hunting links and E-mail correspondents like N8NYU (ssable@foxberry.net) for Detroit and KB8TEP (vincev@juno.com) for Toledo. There are 31 local contacts on my site as I write this. No doubt there will be lots more by the time you read it. Point your browser to http://members.aol.com/homingin/ and leave me an E-mail note while you're there.

In the coming months, I'll have some new RDF projects and reviews of new commercial RDF gear, including a new microprocessor-based Doppler set that is getting a thorough checkout in my van right now. Let me know what RDF topics you would like "Homing In" to cover. Write to the address atop this column, or send E-mail to Homingin@aol.com.

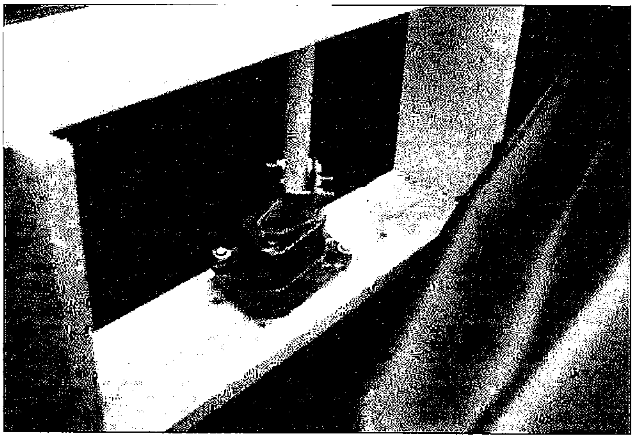

Photo B. *A Ford windshield wiper motor turns N8NYU's mast. Steve says it is important to use the matching Ford bracket to attach the mast to the motor. (Photo by Steve Sable N8NYU)*

HAMS WITH CLASS

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Preparing to prepare the class

The start of the new fall term brings with it all the usual "teacher-type stuff" that one has to do in order to get the school year off to a good start. After more than 18 years of teaching, I am still amazed at the enormous amount of preparation that has to go into laying a solid foundation for the school year. There should definitely be a course in the teacher methodology programs in college on "The Value of Preparedness."

After the class and I discuss the appropriate rules of behavior at our ham shack, and the children are all excited about speaking on the air, I always notice a few of them looking a bit apprehensive. I've developed the perfect thing to introduce at this time. I will say something like, "Probably a few of you are worried that you won't know what to say to the person you will meet on the air." Inevitably, I will then see knowing nods and smiles, as though I've just read their minds. I can almost hear a collective sigh of relief as I pass out a list of questions for them.

"Never ask anything that can be easily answered with a 'yes' or 'no' response."

Use questions

Over the many years of teaching ham radio to 6th, 7th, and 8th graders, I've come up with a list of pivotal questions for the children to use to help them develop some interesting conversations with different folks they will encounter on the air. Obviously, the questions have to be modified according to the background and age of the other person. But it gives my kids a place to start. They feel comfortable holding a sheet of questions in front of them at the beginning. After the second or third time, most of the kids don't need the list. It's a good ice-breaker!

First, the children write out their first names phonetically. Everyone loves to do this. They write out their own background information, like names of brothers and sisters, where they've lived before coming to New York, what their hobbies are, what their favorite school subject is, what singing groups they like, what sports they're interested in, and so on. Now they know they can always fall back on these things in the conversation.

When it comes to asking questions, I tell them never to ask anything that can be easily answered with a "yes" or "no" response. Why not take advantage of this wonderful "live" resource we have? When speaking with other children I like my kids to learn about the differences between their schools in different parts of the country. Are they studying the same things? How much homework do they get? How's their cafeteria food? Most importantly, I list questions that will show how much they have in common with other children. No matter where a child may be from, they all dread tests and report cards, no one likes homework, and all kids like to complain about teachers and too much work.

When speaking to adults, a good question is, "What do you do (or what did you do) for a living?" The children can then ask the other person to describe their workday. What role did ham radio play in the career choice? Is this a good job choice for a young person to consider?

Where are you talking to us from? This question often leads to fascinating responses ... everything from submarines, airplanes, bicycles, motorbikes, boats, to beaches, lighthouses, the Pentagon, the United Nations, the Johnson Space Center, and on and on. Most hams like to share with the children what influenced them to get into the hobby. A good question to follow up with is, "What's the most memorable, or funny, or exciting, or unusual contact you've ever had?"

If you brainstorm with your classes when making up the question list, you will be sure to get some interesting responses. A good classroom discussion can always follow an "inappropriate" question. It's important to teach children that when something offends another person, or invades their privacy, then it stops being fun. This is a hobby to be enjoyed by the participants. In my opinion, discussions about political beliefs or religious principles are better saved for other venues. Respect for other people, being open-minded about differences amongst people, and having an inquiring mind are all side perks that come with the teaching of ham radio to young people.

The importance of being prepared yourself for a lesson is obvious to a good teacher. The importance of passing that technique on to your students is even more important. Have fun!

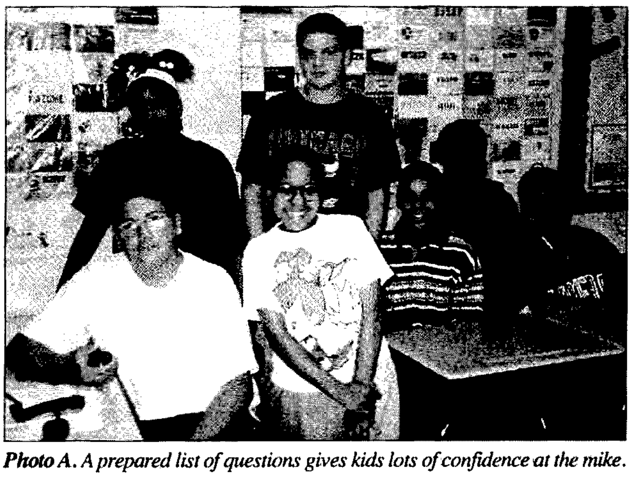

Photo A. A prepared list of questions gives kids lots of confidence at the mike.

Ham Radio Fun

Communications Simplified, Part 11

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The superheterodyne receiver, described in the previous installment, is the cornerstone of modern electronics. The superhet is used in car radios, hi-fi receivers, TV sets, cordless and cellular phones, and even radar detectors. Although the basic block diagram of a superhet is the same regardless of the kind of receiver, there are still quite a few differences between different receivers. We have already looked at some of these differences, such as double-conversion or using a converter instead of separate mixer and oscillator. Let's look at some others.

RF frequency range

Different receivers tune in different ranges of radio frequency signals. For example, a commercial AM radio will tune from 550 to 1650 kHz, while an FM radio will tune from 88 to 108 MHz; a TV set will receive signals between 54 MHz and about 850 MHz, while a radar detector will receive signals around 10 GHz. Thus, the actual circuitry will be different as well. Depending on the frequency range, the antenna will be different, the RF amplifiers and mixers will be different, and even the oscillator must be different.

AM broadcast signal strengths tend to be higher, and so AM broadcast radios usually don't have an RF amplifier (except in car radios), while an FM radio will almost certainly have one. This is usually a cost issue, but there are often technical reasons as well. For example, radar detectors do not have an RF amplifier because amplifying RF signals at radar frequencies is just too expensive. High frequency communications receivers, on the other hand, almost always have an RF amplifier stage—sometimes they even have two.

Selectivity

The required selectivity depends on the bandwidth of the signal. Selectivities often range from just a few hundred hertz (for receivers designed for receiving Morse code or slow-speed digital signals) to 6 MHz (for a TV receiver).

The proper selectivity is often obtained with several tuned circuits tuned to the IF frequency, often with double-conversion to provide lower selectivity without having image problems (see the previous part of this series). But other kinds of filters are also used sometimes, such as ceramic or crystal resonators, or SAW (Surface Acoustic Wave) filters. These kinds of filters use mechanical rather than electrical resonance, to provide a narrower bandpass. But more important, they provide a more stable and repeatable response without having to be individually adjusted.

"But more important, they provide a more stable and repeatable response without having to be individually adjusted."

Stability

They say that a good politician is one who, once bought, stays bought. The same is true of receivers—once a receiver is tuned to a station, it should stay tuned to it. When it does, we say that it is stable; when it doesn't, then we say that it *drifts*.

In a superheterodyne receiver, stability is most affected by the oscillator. In general, oscillator stability is most of a problem when the carrier frequency is high but the bandwidth is small. In this case, even a small percentage change of the oscillator frequency can cause the signal bandwidth to be different from the passband of the receiver.

For broadcast AM receivers, stability is not much of a problem, except perhaps in car radios whose temperature may change tremendously from the time you start driving on a cold day until the heater warms up the entire area under and around the dashboard.

Oscillator drift at higher frequencies is much more of a problem, and so the FM radio's oscillator will probably be quite different. Oscillators in AM radios tend to be spread out on a printed circuit board, while oscillators in FM radios will be very compact, and may even be enclosed in a shielded metal case to prevent outside conditions from affecting the circuit. An automatic frequency control (AFC) circuit (described later) may be used to keep the frequency constant. The AM radio will probably use a converter, whereas the FM radio will most likely use a separate oscillator and mixer.

Another difference lies in the detectors—an AM radio may contain a simple diode to rectify and demodulate the carrier, while an FM radio might use a Foster-Seeley discriminator or some other type of FM detector.

Since the bandwidths of AM and FM signals are different, the IF frequencies will be different. AM radios tend to use a 455 kHz IF (frequencies between 250 and 500 kHz are also sometimes used), while the FM radio will probably use 10.7 MHz.

AM/FM radios will use a combination of the above. Most such radios have completely separate RF and mixer/converter sections for each band, but use a common IF section for both. They do this by connecting a 455 kHz IF transformer in series with a 10.7 MHz IF transformer, and using the same transistor to amplify both. There will be separate AM and FM detectors, but then a common audio amplifier for both. There is obviously an art to getting the most performance from the least number of components.

Once you leave the simple, inexpensive AM and FM broadcast receiver and go either to a more expensive hi-fi or car stereo set, or to the type of receiver used in communications (amateur as well as commercial), then new circuits and options come into play. The rest of this section describes some of these.

Types of oscillators

Some radios (such as the typical home broadcast receiver) are frequently retuned from one station to another; others (like taxicab or oil truck radios) may stay tuned to one particular frequency their entire life. Thus, the oscillator in one radio may be tunable, while the oscillator in another radio may be fixed on one frequency for years. Oscillator design is therefore an important part of the whole design.

Inexpensive radios (such as pocket transistor radios) generally use simple LC oscillators; the frequency is set by an inductor and capacitor. Since components tend to change size and value as the temperature changes, special temperature-compensating capacitors are often used to try to keep the oscillator frequency constant. Even so, many FM radios need an AFC or Automatic Frequency Control circuit to keep the radio in tune because otherwise the LC oscillator would still drift.

Single-frequency radios, on the other hand, generally use *crystals* to set the oscillator frequency. As shown in **Fig. 1**, a crystal is a small piece of quartz, roughly the size of a dime. It has a plated area on each side, and is clamped in its holder between two thin spring-like wires. Because it is only held on its edges, it is free to vibrate.

Quartz is the same piezo-electric material we discussed at the beginning of this series. It converts between electricity and motion: When you bend it, it generates a voltage; if you connect a voltage to it, it bends. In this case, the small disk of quartz has a natural resonant frequency, typically in the range of 0.1 to 25 or so MHz, depending on its size. If you connect it in the feedback path of an amplifier, the amplifier starts to oscillate at the resonant frequency of the crystal. This frequency is very stable, and remains constant (within a tiny fraction of a percent) over a long time.

Crystals must be ordered for the specific frequency you need. Some frequencies (such as the 3.579545 MHz color-burst frequency in a TV set) are used so often that the crystals are mass-produced in huge quantities and cost less than $1 each; crystals for other frequencies may have to be individually made at substantially greater cost.

"These crystals are often (wrongly) called third-overtone crystals."

You may remember that we said crystals typically resonate in the range of 0.1 to 25 MHz or so, whereas the first oscillator in many radios may need to oscillate at much higher frequencies. A higher frequency can be produced in one of several ways.

A typical case might be an amateur radio which needs a first oscillator frequency of 136.24 MHz. This is usually done by using a crystal around 15 MHz, which oscillates on its third harmonic of 45.41333 MHz. Instead of oscillating in one piece, the crystal oscillates in one-third sections at approximately three times its fundamental frequency. This is its third harmonic, which should properly be called its second overtone, but these crystals are often (wrongly) called third-overtone crystals.

Once the crystal generates the 45.41333 MHz signal. A *tripler circuit* then multiplies the frequency by three to make the required 136.24 MHz. A tripler circuit is an amplifier which purposely distorts the signal to produce harmonics; a tuned circuit in the output then selects the third harmonic and deletes the rest. (A doubler would be tuned to the second harmonic; although it is possible to build quadruplers, quintuplers, etc., this is seldom done because of technical problems. Instead, combinations of doublers and triplers are usually used.)

Since crystals have a fairly limited range of frequencies, it is common to use chains of doublers and triplers to multiply the frequencies up to what is needed, or else use digital dividers (flip-flops) to divide the frequency down to a lower value.

Multiplying frequencies up to a higher value by using doublers and triplers is easy for certain values. For example, multiplying a frequency by 12 is easily done with a tripler and two doublers (since 3x2x2=12), but multiplying by 11 or 13, or most other numbers, cannot be done with doublers and triplers. Instead, we use a phase-locked loop (described shortly).

AGC, AVC, AFC, and BFO

This alphabet soup describes a few other circuits often found in receivers. The *automatic volume control* (AVC) or *automatic gain control* (AGC) circuits are basically the same. In each, the output of the detector is sampled to determine how strong a station is. On strong

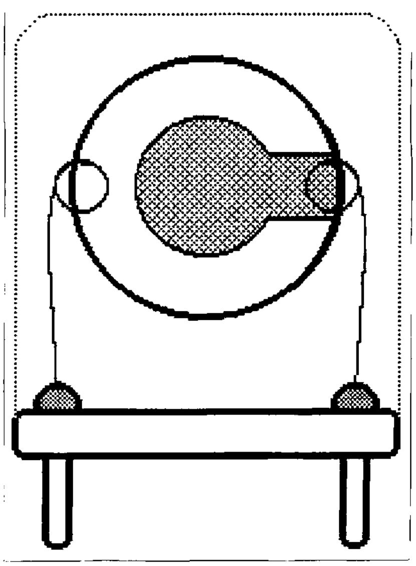


Fig. 1. A quartz crystal.

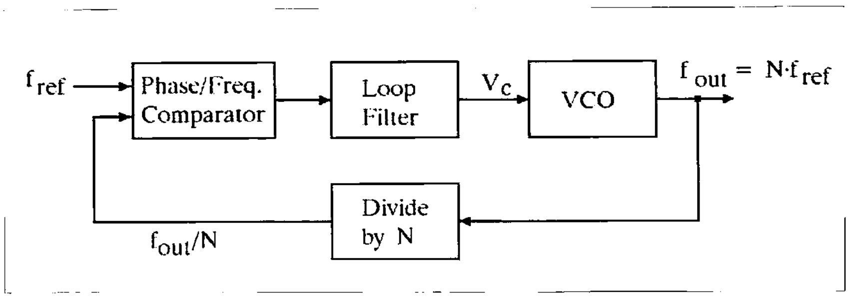


Fig. 2. Block diagram of a phase-locked loop.

stations, this circuit lowers the gain of the IF amplifier, while on weak stations, this circuit increases the gain. Since strong signals are amplified less while weak signals are amplified more, the result is to make both strong and weak signals sound the same.

An *automatic frequency control* (AFC) circuit is used in those FM receivers whose oscillators tend to drift in frequency. While modern receivers with phase-locked loop oscillators don't need the AFC circuit, almost all other oscillator circuits tend to drift and therefore can use AFC. The AFC circuit checks the received signal at the detector to see whether the radio is correctly tuned to the station. If it's not, then it sends a correction signal back to the oscillator, forcing it to either increase or lower its frequency to bring the station back into perfect tune.

The *beat frequency oscillator* (BFO) is used in some older receivers to receive Morse code and DSB or SSB transmissions. When receiving a DSB or SSB signal, the BFO supplies the missing carrier that is needed to go with the sideband(s). When receiving Morse code (called a *Continuous Wave* or CW signal), the BFO supplies a continuous signal near the IF frequency, which beats with the received carrier to produce an audio tone; this is what the operator hears and decodes from Morse code into text.

The PLL (phase-locked loop)

The PLL or *phase-locked loop* is a fairly recent development in electronics. One of its uses is to multiply crystal frequencies by unusual numbers; it has the stability and accuracy of a crystal oscillator but, unlike a crystal, it is tunable.

As **Fig. 2** shows, the PLL circuit looks like a traditional servo loop circuit. Its output comes from a VCO or *voltage-controlled oscillator*. This oscillator generates the frequency we want, but instead of the frequency being controlled by a knob or control of some sort, it is controlled by an input voltage V_c. The VCO can oscillate over a wide range of frequencies, and V_c tells it what frequency to output. Usually, if V_c is high, the output frequency is high, while if V_c is low, the output frequency is low.

Besides going to the output, the f_{out} signal also goes through a digital circuit which divides its frequency by some integer *N*. *N* is usually a variable number, which can be dialed in from some front-panel control, or perhaps is set by a small computer chip in the radio.

The output from the divider circuit is a feedback signal, which now has a frequency f_{out}/N. It is sent back to a *phase/frequency comparator*, which also receives an input reference signal whose frequency is f_{ref}. The comparator looks at the two inputs, and compares their frequencies. If the frequency of the signal coming back through the divider is lower than the input signal f_{ref}, then the comparator sends out an error signal which goes through the loop filter to the VCO and tells the VCO "raise your frequency, it is too low." The VCO frequency then goes up, which raises both f_{out} and the feedback signal to the point where the two inputs into the comparator match. (Of course, if the feedback signal was too high in frequency, the comparator would tell the VCO to lower it.) In this way, the PLL varies the VCO frequency up and down so it can lock it at the value that makes the two inputs into the comparator equal. When this happens, we say that the loop is *locked*.

In operation, the f_{ref} input signal usually comes from a crystal oscillator, and is very stable. Since the digital divider circuit divides by a number *N* which is also exact (it is an exact integer), the output signal f_{out} is exactly equal to $N \times f_{ref}$, and is therefore also very stable.

The secret of the system lies in the divide-by-*N* circuit. This is a digital circuit which, with just minor changes, can divide by many different values of *N*, and each different *N* produces a different output frequency.

For example, suppose you needed an oscillator tunable to any exact point between 10 and 20 MHz. It would be almost impossible to get that sort of accuracy from an LC oscillator, and it would be very expensive to use 10 different crystals, one for each frequency. Instead, you could use a PLL with a 1 MHz crystal, and a divider which can divide by any integer between 10 and 20. If the crystal was accurate to, say, ±0.001%, then the output frequencies would be just as accurate. A PLL used like this to generate many different output frequencies is called a *frequency synthesizer*.

Phase-locked loops are very common today. If you have a car radio with a digital readout, it most likely uses a PLL to set the exact receive frequency. Before PLLs, a six-channel walkie-talkie needed six crystals for the receiver, and another six for the transmitter, just to set the frequencies; modern synthesized walkie-talkies can access hundreds of transmit and receive frequencies with just two or three crystals.

"The secret of the system lies in the divide-by-*N *circuit."

Before we leave phase-locked loops, we should mention a few other uses.

One use is as an FM detector. Suppose we replace the divide-by-*N* circuit with a plain wire (which makes *N* equal to 1, so the output frequency is the same as the input reference frequency). Further, let the f_{ref} signal, rather than being a very stable reference signal, be an FM modulated signal (perhaps coming from the IF amplifier in a receiver). As the signal frequency deviates back and forth, the PLL will keep the loop locked, forcing the VCO frequency to vary up and down in step with the input signal. The V_c signal going into the VCO tells the VCO what it has to do to match the input frequency change. In other words, the V_c signal goes up and down with the frequency—it is the demodulated output.

The PLL has one very useful characteristic: Given enough time, it can lock onto an input reference signal, even if that signal is buried in noise. It is therefore an excellent circuit for detecting very weak signals. Furthermore, since the VCO output frequency is the same as the input frequency—but without the noise— the PLL can be used to "clean up" noisy signals. The disadvantage, however, lies in the words "given enough time." The more noise there is in the input signal, the slower the PLL will lock up; hence, the signal must deviate slowly or the PLL will unlock and lose it.

Direct digital synthesis

Direct digital synthesis is a newer way of generating adjustable, yet very precise, frequencies. This approach has only become practical in the last few years, with the arrival of some very fast integrated circuits.

Fig. 3 shows the idea. The top waveform in the figure shows a typical sine wave you might want to generate. The first step is to take some very careful measurements of the height of the wave. For example, at the very left, we show an amplitude of 0 volts. A bit further on, the wave has a height of 0.174 volts. A bit farther on, the height is 0.342 volts, and so on. You do this for the entire length of one cycle.

The next step is to build a digital circuit that stores these measurements as binary numbers, and that can output them at high speed. The trick is to control the output speed so that the measurements come out at the exact instant when the wave should be at that amplitude. For example, if you took 10 measurements of the sine wave, and wanted an output of 1 MHz, then you would need 10 x 1,000,000, or 10,000,000 numbers to be output in exactly one second. You can see why this requires some very fast circuitry.

Once you have this digital circuit, which is spitting out numbers at a very fast rate, telling you how high the wave should be at any particular instant, you need to convert those numbers back into voltages. This is done with a *digital-to-analog converter*, which accepts the digital numbers and converts them into analog voltage.

Since the digital numbers represent specific points on the curve, and not the full sine wave itself, the output is the lower curve shown in **Fig. 3.** While this sort of looks like a sine wave, it has a lot of steps in it which represent the missing data. Fortunately, these steps represent high frequency signals which are easily removed with a low-pass filter, giving us a sine wave again.

An interesting article in the August 1993 issue of *73* showed how to use the Harris HSP45102DC direct digital synthesizer IC to build the "Julieboard" transceiver. The Harris IC is the digital IC which outputs the digital values for the sine wave; you just tell it the frequency you want, and it outputs the values at just the right rate to put the frequency right on the dot.

Subcarriers

A subcarrier is a carrier which is carried on top of another carrier. Here is an example of a common use: Suppose you have some music, such as what I call elevator music, which you'd like to broadcast to paying customers in a city. But you don't want to spend money to build a broadcast station; moreover, you don't want the music to be interrupted by commercials or even station call letters. You also don't want the public to hear this music for free, because you want to charge your customers for providing them with commercial-free background music for their stores or buildings.

For this application hi-fi music isn't needed, so let's suppose that the music has a frequency range up to perhaps 5 kHz or so. So you amplitude modulate it onto a carrier of, say, 91 kHz. The result is a 91 kHz carrier with sidebands extending from around 86 kHz up to about 96 kHz. These frequencies are well above human hearing, but still too low to efficiently transmit over the air—the antenna would be too long.

You therefore make a deal with a local FM broadcast station to transmit this signal for you. Because your carrier frequency is well above the range that the ear can hear, they can mix it into their audio signal without their own listeners being able to hear it. So we now have a main carrier (the FM station's carrier between 88 and 108 MHz) which carries both the regular FM station's signal, as well as your carrier signal, which occupies 86 to 96 kHz. Your carrier is now a *subcarrier*, riding on top of another carrier.

The system just described is actually quite common; FM stations call it an SCA subcarrier, and may use it not just for background music, but also for foreign-language programs, paging signals, or even digital data such as stock market prices. Another example is the color subcarrier in a TV signal; this is a 3.579545 MHz subcarrier, riding on top of a standard TV signal, that carries the color information.

Stereo FM

Stereo FM is another example of how a subcarrier is used to carry additional information on an FM signal, but it is a bit more complicated than the plain SCA approach. **Fig. 4** shows one way to do this. (Actually, **Fig. 4** shows how this was done in early stereo transmitters; modern transmitters use a digital approach called TDM, but its explanation will have to wait until a later section.)

The signals from the left and right microphones of a stereo signal are amplified by two audio frequency (AF) amplifiers, and sent to a *matrixing circuit* consisting of four resistors. Resistors R1 and R2 take the left and right signals (called L and R in the figure) and mix them into a signal called L+R. This *sum* signal combines the left and right signals into one for those listeners who have a mono rather than a stereo receiver. These listeners therefore get all audio, though both the left and right channels play through a common channel.

At the same time, an inverter takes the R signal and inverts it into a signal called -R. Resistors R3 and R4 combine this with the left signal into the L-R signal. This *difference* signal represents only the difference between the left and right channels. For example,

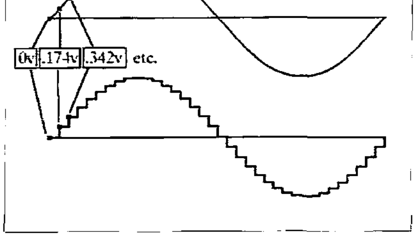


Fig. 3. Digital synthesis of a sine wave.

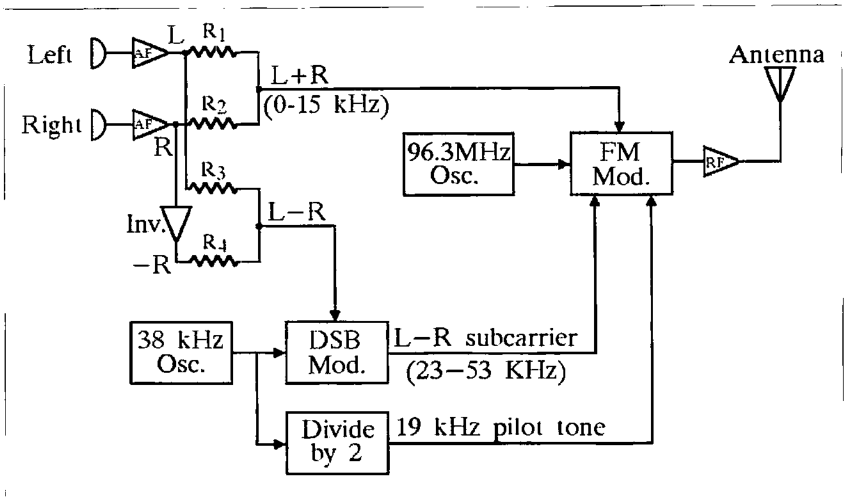


Fig. 4. An FM stereo transmitter.

if a singer is picked up equally by the left and right mikes, the two signals will cancel out (since the R signal is inverted) and not appear in the L-R signal. Instruments at the left or right, on the other hand, will appear mainly in one channel or the other, and so will not cancel out.

The L-R signal is modulated onto a 38 kHz subcarrier in a double-sideband (DSB) modulator. If the audio extends from about 0 to about 15 kHz, then the sidebands will extend ±15 kHz out from the subcarrier, or from about 23 kHz to about 53 kHz.

At the same time, the 38 kHz carrier signal is divided by 2, to produce a 19 kHz signal called the *pilot tone*. This signal is exactly 1/2 the frequency of the 38 kHz carrier.

All three of these signals—the main L+R audio signal, the DSB L-R subcarrier, and the pilot tone—are fed to the main FM modulator, which modulates all three of these onto the main FM station carrier (shown as 96.3 MHz in this example.) The 38 kHz subcarrier (or actually, its upper and lower sidebands, since the carrier itself is not there) therefore becomes a subcarrier on the main carrier. **Fig. 5** shows the resulting spectrum, which looks like this:

- •Main L+R signal , up to 15 kHz
- •Pilot tone, 19 kHz
- •L-R lower sideband, 23 to 38 kHz
- •Missing carrier (not shown), 38 kHz
- •L-R upper sideband, 38 to 53 kHz
- •Room for possible SCA subcarriers, from 53 to 100 kHz

With signals extending up to a possible 100 kHz, the overall bandwidth of the FM signal can be up to 200 kHz.

Why is the subcarrier DSB rather than plain AM or FM? For two reasons. First, it is not FM because an FM subcarrier at any reasonable modulation index would have an excessive bandwidth: it would extend down below 23 kHz, and start to interfere with the main L+R channel. And it is not AM because that would increase overall noise. Remember that each time a subcarrier is added to the main carrier the volume level of the main signal (the L+R signal in this case) has to be reduced to prevent the overall signal from being over-modulated. By omitting the subcarrier itself, and including only its sidebands, less reduction of the main signal is needed. This provides a louder, less noisy signal to listeners far away from the transmitter.

But, as we mentioned in a previous installment, DSB is not normally used for transmitting music or high quality audio since it is too difficult to re-insert the carrier exactly halfway between the two sidebands. This is where the 19 kHz pilot tone comes in—the receiver will double its frequency to 38 kHz, exactly midway between the two DSB sidebands. The pilot tone is transmitted at a very low level, just strong enough so it can be separated out and its frequency doubled. In this way, the pilot tone helps the receiver provide a carrier at exactly the right frequency, so that the DSB signal can provide good quality audio after all.

Once the receiver demodulates the L-R signal, it uses another matrixing circuit to mix the L+R and L-R signals and produce the pure left (L) and right (R) signals. This is usually shown with the following equations:

(L+R) + (L-R) = 2L (pure left)
and
(L+R) - (L-R) = 2R (pure right)

This rather complex approach to stereo has two inherent advantages. First, the L+R main signal provides a compatible signal for listeners with mono receivers; compatibility was a very important criterion when the FCC decided on this stereo system. Second, The L-R signal is somewhat more prone to noise pickup than the L+R signal; since it is mixed equally into both the left and right channels, the noise comes equally out of both channels. This is more acceptable to listeners than having one good channel and one bad channel. And if the noise does become too high for comfort, the user can always switch the receiver back to mono mode; the radio then receives only the L+R signal, which avoids the noise of the L-R signal.

Incidentally, in addition to the stereo subcarrier, FM broadcast stations can also have one or two SCA subcarriers. Though adding all these signals does reduce the overall signal-to-noise of the station, the economics of charging extra for SCA channels does make it attractive to many stations.

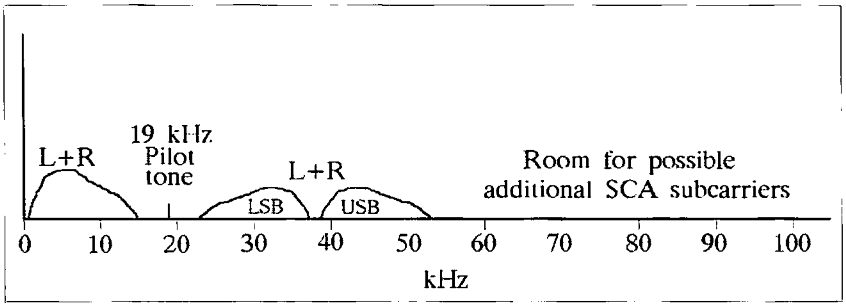


Fig. 5. Stereo FM spectrum.

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the February issue, we should receive it by November 30. Provide a clear, concise summary of the essential details about your Special Event.

OCT 26

HOLLAND, MI The Holland ARC will sponsor the Lakeshore Hamfest and Computer Expo, 8 AM-1 PM, at the Holland Christian H.S. Vendor set up Fri., Oct 25th, 6 PM-9 PM. To reserve tables, call *(616) 772-0367*, or mail to *Hamfest, c/o Peter Venlet, 536 Huizenga St., Zeeland MI 49464-1423*. VE Exams will be available. Talk-in on 147.060 and w/ 94.8 pi.

MONTREAL, QUEBEC The Montreal South Shore ARC will hold its annual Hamfest at Place Desaulniers, 1023 Taschereau Blvd., Longueuil PQ. Set up Sat., 6 AM-9 AM. Open to the public 9 AM-3 PM. Wheelchair accessible. Talk-in on 145.390(-). Contact *Francois Drien VE2FDA, 160, Rolland Crescent, Greenfield Park PQ, Canada J4V 2Y2. Tel. (514) 672-9994; Fax: (514) 672-9361. E-mail: fradrien@ulix.net. Packet: VE2FDA@VE2RKY.#MTL.PQ.CAN.NOAM.* Visit the Hamfest WEB page: *http://www.cam.org/~pfisch/hamfest.html.*

NOV 1

FEEDING HILLS, MA The Hampden County Radio Assn. will hold its annual Auction at the Feeding Hills Congregational Church on North Westfield St. (next to the intersection of Route 187 and Route 57). Items are limited to amateur radio, electronics, or computer. Doors open at 6:45 PM. The Auction begins at 7:30. Free admission. The H.C.R.A. retains 10% (up to a maximum of $10). For complete rules or directions, contact *Steve WA1EYF, (413) 596-6216 before 10 PM.*

NOV 2

ENID, OK The Enid ARC Hamfest will be held 8 AM-5 PM in the Hoover Bldg. at Garfield County Fairgrounds. Talk-in on 145.290 or 444.400. VE Exams by W5YI at 1 PM. Contact *Fred N5QXJ, Tom N5LWT, Dick N5HEL, or Jeff N5UBY at EnidARC@AOL.COM:* or write to *Enid Amateur Radio Club, P.O. Box 261, Enid OK 73702.*

NOV 3

KAUKAUNA, WI The Fox Cities ARC annual Hamfest will be held at the Starlite Club, corners of Hwy. 55 and Cty. Rd. JJ. Reg. for VE Exams starts at 8 AM, testing starts at 9 AM. No walk-ins after 9 AM. Bring original license plus 2 copies, and a photo ID. For exam info contact *Larry Siebers KD9IA, (414) 757-1167.* Talk-in on 146.52 simplex or 146.76 Rptr.

NOV 9

HERSHEY, PA A Special Event will be hosted by the Central PA Rptr. Assn. at Hershey Armory, off 422. For details contact *Harold Baer KE3TM, 619 W. 2nd St., Hummelstown PA 17036; Tel. (717) 566-8895.* Ask about VE Exams.

MONTGOMERY AL The Montgomery ARC will host the 19th annual Montgomery Hamfest and Computer Show, in Garrett Coliseum at the South Alabama State Fairgrounds on Federal Dr. Flea Market set up 3 PM-8 PM Fri., Nov. 8th, and 6 AM-7:30 AM, Sat., Nov 9th. Doors open to the public 8 AM-3 PM CST. VE Exams on-site beginning at 8 AM. Bring original and a copy of your current license, picture ID, and $3.00. Talk-in on 146.24/.84 W4AP. Rag-chew on 146.32/.92 (with phone patch ±), 147.78/.18, 449.50/444.50. Flea Market reservations are encouraged. Nearest lodging at Coliseum Inn across the street; call *(334) 265-0586* or *1-800-876-6835*. For info or reservations, contact *Hamfest Committee, c/o 2141 Edinburgh Dr., Montgomery AL 36116-1313;* or phone *Phil at (334) 272-7980 after 5 PM. Fax: (334) 365-0558; E-mail: WB4OZN@worldnet.att.net.*

MYRTLE BEACH, SC The Grand Strand ARC Hamfest will be held 9 AM-4 PM at Myrtle Beach H.S. Talk-in on 147.120. For info, contact *Matt McGuire KF4AIT, (803) 215-0474;* or *David Berry KE4OOW, (803) 248-9401.*

NOV 10

BRANFORD, CT The SouthCentral CT ARA will hold its 17th annual Flea Market at the Branford Intermediate School, 185 Damascus Rd. Sellers 7 AM, buyers 9 AM. Wheelchair accessible. VE Exams. Talk-in on 146.01/.61. Reservations by mail only, no later than Nov. 1st: SASE to *SCARA, P.O. Box 705, Branford CT 06405-0705.* For info call *(203) 483-0856, 24 hrs.*

NOV 17

BENSON, NC The Johnston ARS, Inc., will hold "JARSFEST96" 8 AM-4 PM at the American Legion Complex on Hwy. 301 N. For info contact *Bill Lambert AK4H, 8917 Hwy. 50 N., Benson NC 27504. Tel. (919) 894-3352, eves. 7 PM-10 PM.*

NOV 30

EVANSVILLE, IN The 4th annual E.A.R.S. Evansville Winter Hamfest will be held 8 AM-2 PM (Central time) at Vanderburgh County Fairgrounds. Set up at 6 AM. Contact *Neil WB9VPG at (812) 479-5741; or write to EARS, 1506 S. Parker Dr., Evansville IN 47714; or E-mail EARSHAMaol.com.* The Hamfest Web Site is *http://users.aol.com/earsham/earsham.html. Talk-in on* EARS wide area Rptr Network 145.150(-) Evansville/146.925(-) Vincennes. Alternate: EARS Rptr. 145.110(-).

LITCHFIELD, IL The Central Illinois/St. Louis Area ATV Club will hold their 10th Annual Banquet at the Ariston Restaurant In Litchfield, beginning with a Happy Hour at 5 PM and Dinner at 6:30 PM. After the meal, there will be various award presentations to members. Those active or interested in ATV are invited to attend. Contact *Scott Millick K9SM, 907 Big Four Ave., Hillsboro IL 62049. Tel. (217) 532-3837, or E-mail to smillick@cnmnet.com.* Reservations are required in order to attend.

NEWTONVILLE, MA An Amateur Radio and Electronics Auction will be held by the Waltham ARA and 1200 RC at Newton Masonic Hall, 460 Newtonville Ave. For more info contact *Eliot Mayer W1MJ, (508) 664-0773, W1MJ@AMSAT.ORG.* The Auction Web Page is *http://ourworld.compuserve.com/homepages/emayer/auction.htm.*

SPECIAL EVENT STATIONS

NOV 9-10

LAKE HIAWATHA, NJ The Irvington-Roseland Amateur Club will operate the club station, K2GQ Nov. 9th and 10th 1400Z-2100Z, in celebration of the club's 51st Anniversary, "IRAC the Next 50 Years." Operation will be in the General portions of 80, 40, 20, and 15; the Novice portion of 10 meters, and 146.52.

NOV 30-DEC 1

PLYMOUTH, MA The Whitman ARC will operate Station WA1NPO at historic Plimoth Plantation, in commemoration of Thanksgiving. Freqs.: 3.970, 7.270, 14.270, 18.140, 21.370, 24.970, and 28.370; 1400Z-2100Z hrs. each day. A special QSL card will be sent to Hams and SWLs sending an SASE. Also, a 7 1/2" x 10" certificate with the Mayflower II in the background is available for the event. All replies must be sent to *Whitman ARC, P.O. Box 48, Whitman MA 02382.*

LETTERS

Continued from page 69

have no formal education and are unqualified. Their goal is to create a bigger demand for their services, which increases the need for the agencies' services, which in turn means bigger budgets, with promotions and salary increases for all.

Most local agency administrators quickly learn that they can get away with expenditures such as parties (conferences), cell phones, cars, plush offices, et cetera, because the federal and state agencies are dependent upon local expenditures to justify their bigger budgets. This is going on from Florida to California. Most northern states that have no need for migrant farm workers are not aware of this.

I know this because I worked five years for the Western Arizona Council of Governments (WACOG) in Yuma, Arizona. The description I have given is an accurate assessment of what I witnessed going on. Their local Congressman, Ed Pastor (a liberal Hispanic Democrat) is all in favor of this.

Be sure and pay lots of taxes, Wayne. The people at these agencies and on the other give-away programs appreciate it.

Well, it's easy to see why we have more people working for the government than in manufacturing. We don't want their children to go hungry so let's push Congress to increase our taxes and give everyone a raise for a job well done ... Wayne.

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
P. O. Box 473
Stevenson MD 21153

Over the past few months, we have covered the what, why, and how of radioteletype; this month, let's take a look at the where.

From the beginning of amateur radioteletype, hams have clustered their activities at the low end of the ham bands, in order to facilitate contacts as well as minimize interference to other forms of communications. For "standard" Baudot radioteletype, look around the low end of 80 meters, at 3620 kHz, or on 20 meters near 14080 kHz, most times of the day. You certainly may find RTTY on other frequencies, but these are good starting places on HF.

On VHF, you will do best to check around on local repeaters, as local custom puts AFSK RTTY all over the place. In some areas, activity may be concentrated near 145 MHz, while in others it may be up near 147 MHz. Other bands' activities may be similarly influenced by local practices. Ask around.

Help on CD-ROM

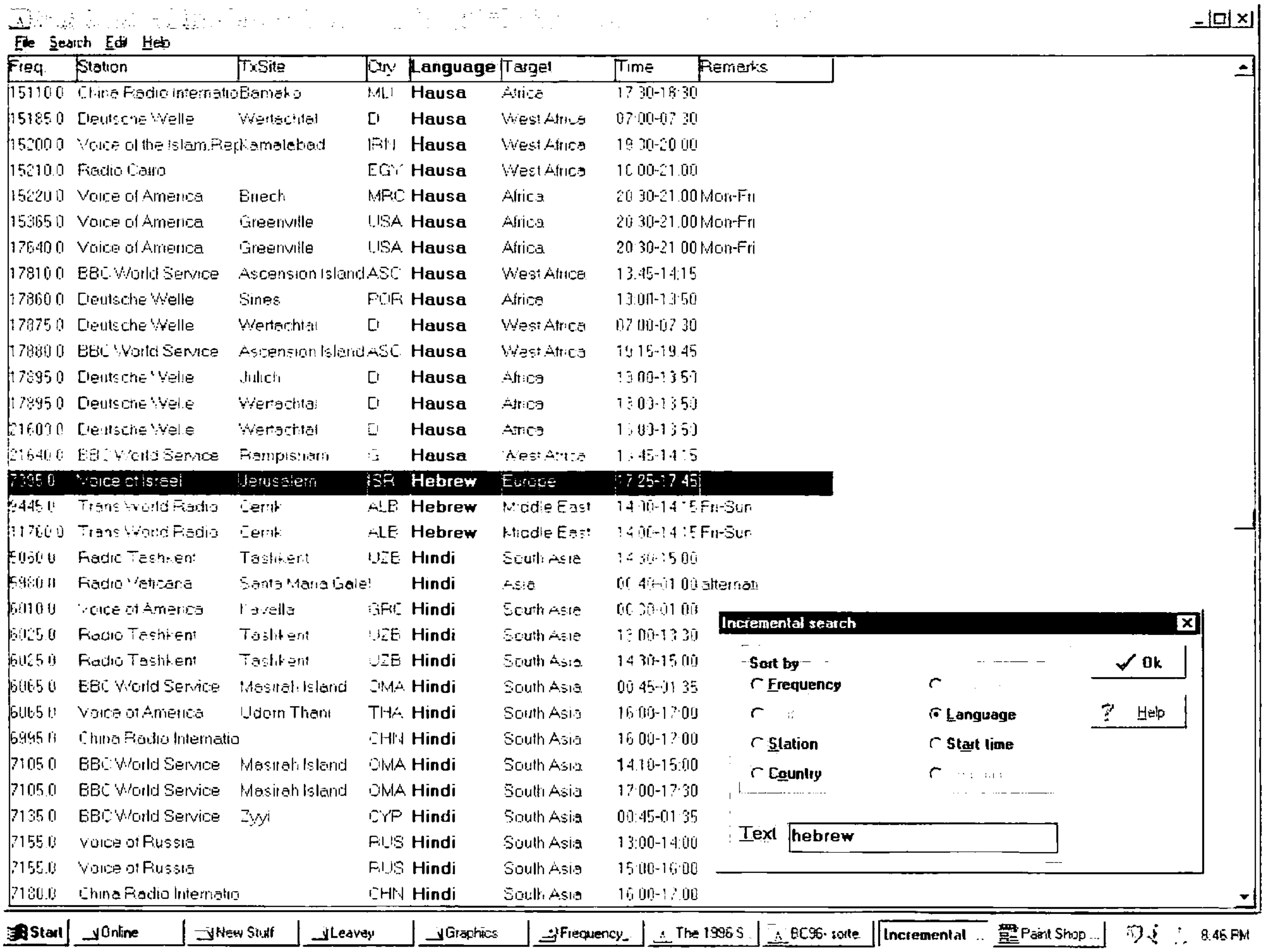
While our activities may be confined to the ham bands, radioteletype itself is hardly so confined. A useful tool for searching for some of those frequencies has been put out by Jeorg Klingenfuss, in the form of the 1996 Super Frequency List, a CD-ROM which stores all kinds of broadcast information.

The revised software of this disk runs under Windows 3.x® or Windows 95®, and features concurrent word search facilities and individual tables to evaluate some 8,500 entries with the latest schedules of all international broadcasting services on shortwave. The English and German search engine can seek out radioteletype stations and sort them by frequency, identifier, country or language, or combinations of keys. **Fig. 1** is a screen shot of a search for Hebrew language stations, showing the kind of information available. There are even other lists of 1,000 abbreviations and 12,820 formerly active frequencies, all on one compact disk. The current price is DM60, and the disk is available from Klingenfuss Publications, Hagenloher Str. 14, D-72070 Tuebingen, Germany. For more current information on this, or other Klingenfuss publications, check out Jeorg's home page at: http://ourworld.compuserve.com/homepages/Klingenfuss/ and let him know that you read about him in this column.

"What exactly would I need, besides the C-64 and a 2 meter transceiver, etc., to be packet capable?"

Help wanted

David Sebastio (sebastio@tesco.it) has been studying for an Italian ham license, and may well have it by now. He has been looking for RTTY and ham applications for the Mac. This has been a long-standing problem, which has been addressed here before. I have found some material on America



Freq.	Station	TxSite	Ctry	Language	Target	Time	Remarks
15110.0	China Radio Internatio	Bamako	MLI	Hausa	Africa	17:30-18:30	
15185.0	Deutsche Welle	Wertachtal	D	Hausa	West Africa	07:00-07:30	
15200.0	Voice of the Islam.Rep	Kamalabad	IRN	Hausa	West Africa	19:30-20:00	
15210.0	Radio Cairo		EGY	Hausa	West Africa	10:00-21:00	
15220.0	Voice of America	Briech	MRC	Hausa	Africa	20:30-21:00	Mon-Fri
15365.0	Voice of America	Greenville	USA	Hausa	Africa	20:30-21:00	Mon-Fri
17640.0	Voice of America	Greenville	USA	Hausa	Africa	20:30-21:00	Mon-Fri
17810.0	BBC World Service	Ascension Island	ASC	Hausa	West Africa	13:45-14:15	
17860.0	Deutsche Welle	Sines	POR	Hausa	Africa	13:00-13:50	
17875.0	Deutsche Welle	Wertachtal	D	Hausa	West Africa	07:00-07:30	
17880.0	BBC World Service	Ascension Island	ASC	Hausa	West Africa	19:15-19:45	
17895.0	Deutsche Welle	Julich	D	Hausa	Africa	13:00-13:50	
17895.0	Deutsche Welle	Wertachtal	D	Hausa	Africa	13:00-13:50	
21600.0	Deutsche Welle	Wertachtal	D	Hausa	Africa	13:00-13:50	
21640.0	BBC World Service	Rampisham	G	Hausa	West Africa	13:45-14:15	
7395.0	Voice of Israel	Jerusalem	ISR	Hebrew	Europe	17:25-17:45	
9445.0	Trans World Radio	Cerrik	ALB	Hebrew	Middle East	14:00-14:15	Fri-Sun
11760.0	Trans World Radio	Cerrik	ALB	Hebrew	Middle East	14:00-14:15	Fri-Sun
5050.0	Radio Tashkent	Tashkent	UZB	Hindi	South Asia	14:30-15:00	
5880.0	Radio Vaticana	Santa Maria Galeria		Hindi	Asia	00:40-01:00	alternati
6010.0	Voice of America	Kavalla	GRC	Hindi	South Asia	00:00-01:00	
6025.0	Radio Tashkent	Tashkent	UZB	Hindi	South Asia	13:00-13:30	
6025.0	Radio Tashkent	Tashkent	UZB	Hindi	South Asia	14:30-15:00	
6065.0	BBC World Service	Masirah Island	OMA	Hindi	South Asia	00:45-01:35	
6065.0	Voice of America	Udorn Thani	THA	Hindi	South Asia	16:00-17:00	
6995.0	China Radio Internatio		CHN	Hindi	South Asia	16:00-17:00	
7105.0	BBC World Service	Masirah Island	OMA	Hindi	South Asia	14:10-15:00	
7105.0	BBC World Service	Masirah Island	OMA	Hindi	South Asia	17:00-17:30	
7135.0	BBC World Service	Zyyi	CYP	Hindi	South Asia	00:45-01:35	
7155.0	Voice of Russia		RUS	Hindi	South Asia	13:00-14:00	
7155.0	Voice of Russia		RUS	Hindi	South Asia	15:00-16:00	
7180.0	China Radio Internatio		CHN	Hindi	South Asia	16:00-17:00	

Fig. 1. A screen shot of the Super Freq List in use.

Online™, but precious little elsewhere. Readers with good information are invited to send contributions to David, who I am sure would appreciate it, as well as to bring such material to my attention. Depending on size, we may be able to offer some of the material on the RTTY Loop Home Page.

Speaking of that home page, some miscellaneous notes include a word of thanks for the comments to Mike Stapp (stapp001@gold.tc.umn.edu), a regular reader of this column and visitor to the page who, along with others, has offered suggestions and comments. Watch the page for implementation of some of these items in the future. Hopefully, Antonio Hernandez Garza XE2HWH (hgarza@bestit.dgit.seit.mx) has used some of the material from the RTTY software collection to get his Kenwood TS-530S onto RTTY with his PK-232. I look forward to hearing from Mexico on this. Dale Fravel N2LWY (dlf@rfpo1.rfc.comm.harris.com) is looking for information on DS RTTY, as well as software to accomplish this mode. Again, any of you who have information for Dale, please send it to him, and let me know about it, too, OK?

Using old equipment

Michael Shovan WB2KHE, says that he has enjoyed reading "RTTY Loop" almost as long as *73* itself. While not yet equipped for the mode, he still finds the topic of interest. His only practical exposure was with the big, old, clunky monsters the wire services used to provide for radio station news departments as late as the mid-'70s (when he was last in the "biz").

Some years ago, he tried the RTTY receive program for the CoCo but couldn't get it to work, especially with a direct feed from a shortwave broadcast receiver headphone jack. (The program was keyed into an executable file from the magazine listing and stored on disk.) He had always wanted to make it work, but never got to pursue it.

Fig. 2. The CD-ROM Klingenfuss 1996 Super Frequency List.

Packet quickly put an end to all that for him at the time.

Well, Michael, as originally printed, there were a few errors in that listing, which prevented it from working as published. A correction ran a few months later. So, anyone who is still running a CoCo is cautioned to check for that correction before putting fingers to keys. As to those "old, clunky monsters," watch it—many, many hams are still using those machines. I also appreciated Michael's remarks about my other page, A.J.Recordings, the official web page for Al Jolson. You all can check that one out at: http://www2.ari.net/ajr/recs/. Notice the subtle difference in URL from the RTTY Loop Home Page.

Speaking of those old monsters, another Italian reader, Guido Sesani (bonefish@gpnet.it) sends a message detailing his problems. An old SWL, he recently rejoined the world of RTTY with an old Telereader CWR 670E (do not smile please!!) and a Yaesu FRG-100. He wrote because he absolutely does not remember how the Telereader works, and the only transmissions he gets clearly are CW. So, once again, I ask all of you if anyone has an original manual for the Telereader, a copy of which could be sent to Guido. Drop him a message if you can help him, and let me know so that I can thank you as well.

"The Klingenfuss CD-ROM can seek out radioteletype stations and sort them by frequency, identifier, country or language, or combinations of keys."

C-64 help

A reader with a piece of equipment not so old, but not so new, either, is Harry Johnson NV7K/6 (panda@northcoast.com) who writes:

"I have been reading your column in *73* for a long time, even though I am not active in any way on any of the digital modes. I do enjoy reading it anyway. I have enjoyed looking at the web sites that you mention each month, and for various reasons have included some on my hot list. I just did so with the RTTY Loop Home Page. Very interesting.

"I have a C-64 sitting in a box and have for some time had some randomly recurring thoughts about using it for packet. I have read some about 'poor man's packet,' etc., and know that there are terminal-emulating programs for the C-64 that facilitate its use for packet. As you can see, I am totally inexperienced in the digital modes. Anyway, what exactly would I need, besides the C-64 and a 2 meter transceiver, etc., to be packet capable? Where is the necessary software available?

"People usually snicker softly when I mention the C-64, and say 'Use your PC!' I use the PC for too many other things, and the C-64 is just sitting there. My expectations are not excessively high, anyway. I would just like to have the ability to communicate with some friends via packet."

Harry, there are a lot of C-64s on RTTY, and they get out just fine. Anyone who would snicker at you would probably do the same to someone driving an inexpensive car, but it will take you to your destination just as well as a luxury model. Among the solutions I have seen, the most elegant may be the old Microlog ART-1 system, being sold by G & G Electronics of Maryland for less than $50. Check with them and see if they still have any left, at (301) 258-7373, and tell them you read about it here. If they have run out by the time this is published, they may well have a handle on other solutions to your problem.

Several times in this month's column the RTTY Loop Home Page has been highlighted as the source of information, and the means of contacting me. Those of you with Web access can check it out for yourselves at: http://www2.ari.net/ajr/rtty/. There have been thousands of hits there to date. I have not said much about the RTTY Loop Software Collection lately; next month I hope to highlight a few new programs in the pot. Meanwhile, drop me a line and let me know what you are looking for, or what you have to contribute. E-mail me at: ajr@ari.net, or on America Online at: MarcWA3AJR, or on CompuServe at: 75036,2501, or scrawl me some snail mail via the post office box above. Just do it! 73

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2304 MHz and above microwave transverters

Last month I discussed some of the conversion aspects of the Qualcomm synthesizer and our Microwave Group's use of this surplus material. Those of you interested in obtaining the PC board to modify it into a functioning local oscillator may contact me at the above address.

The best example I can give is shown in last month's photographs from Kiotsugi Tanumara JG1QGF. He made a very simple, neat packaging of the synthesizer that is not only attractive in layout, but also extremely straightforward in operation.

The Qualcomm synthesizer outputs frequencies in the 2160 to 2700 MHz range. Some units are restricted to a lesser frequency range determined by a more tightly constructed VCO on the PC board. These units will not go below 2400 MHz and thus are used with 10 GHz transverters requiring a 144 MHz IF and a local oscillator at 2556 MHz. This arrangement makes for a perfect fit of VCO capabilities and VCO performance.

The synthesizer frequencies I use are based on the use of a 144 MHz multimode radio as the IF (intermediate frequency), and various multiples of the output from the synthesizer as the injection frequency. For example, to operate on 2304 MHz, I use an LO (local oscillator) frequency of 2160 MHz (2160 + 144 = 2304). To operate on 3456 MHz, a local oscillator of 828 MHz is quadrupled, mixed with the IF, and output as 3456 ((4 x 828) + 144 = 3456). If I want to get on 1296, the 2304 is divided by two before mixing ((2304 / 2) + 144 = 1296). Ten gigahertz operation is available well ((2556 x 4) + 144 = 10368).

What system you use for a local oscillator, be it a crystal oscillator or a more sophisticated synthesizer, doesn't matter. What is required here is a local oscillator that is accurate; accuracy is the prime ingredient and reigns supreme. The alternative is frequency uncertainty and an unstable oscillator. It will work but it's like driving a car—you must continuously adjust your system just like the steering wheel. To a radio system this approach is impractical and is considered a bottom-dollar solution.

Now, with the local oscillator in tow and a simple practical filter to construct with again simple components, try putting together a converter for one of the frequencies you have chosen to construct. The choice of frequency is yours, but I would suggest that you select one for which you already have some of the components on hand in order to hold down the cost of

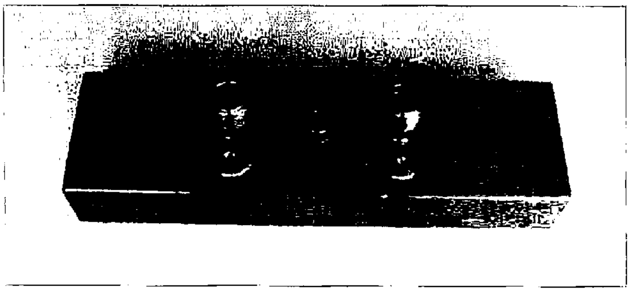

Photo A. The waveguide filter, constructed out of 10 GHz waveguide 1" x 1/2" x 3" long. The connectors used were long-tip SMAs, and the screw was a 4/40 brass screw and lock nut.

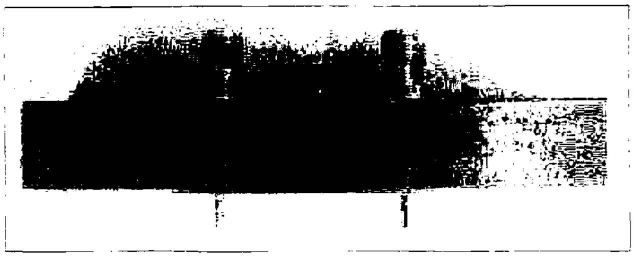

***Photo B.** Side view of the same filter shown in **Photo A.** Notice the long pins on the coaxial connector protruding and soldered on the rear wall of the waveguide. The 4/40 screw is centered in the waveguide between the two coaxial SMA connectors. In the case of lower frequency filters, the screw is replaced by a Johanson microwave variable capacitor.*

components. If you attempt a converter for which you must purchase all the components this will undoubtedly become a somewhat expensive project. Projects should be fun and interesting, and should not cause pain to the pocketbook. While we will make available all the components that we have on hand to help you construct some of these converters, make use of supplies you can find locally to hold down your costs. We are doubt and have several SMA long-stem coaxial connectors to experiment with, construct several of various lengths. I used 1/2" spacing in almost all of my filters.

This spacing from the variable Johanson capacitor was acceptable in performance, to my tastes. For a more exacting filter in terms of loss and bandwidth characteristics, try constructing a few and select the best method you have at hand. Remember: If you change the

"This might seem a little unusual—using a single amplifier for a dual purpose—but it works well in low power systems."

presenting several completed system ideas to demonstrate how we attacked the construction area on different frequencies. Almost all of the material can be obtained from us; more on that later.

More on the filter

The next item I want to cover is the filter that we introduced last month. The filter shown in **Photo A** is quite a simple one, and even when constructed with dimensional inaccuracies, it will still be capable of reasonable operation. The limits of your construction depend mainly on the components used for the capacitor and on its physical size and value. The filter response curves will be affected by the distance between the coaxial connectors, the size and value of the filter, and the size of the waveguide used. If you are in

ingredients you will change the type of cake you are baking. It should not matter to a great extent if you use different types of connectors and variable capacitors. Just keep in mind that if you stray far, you must be prepared to adjust the circuit to suit the components used. I stayed with miniature SMA coaxial connectors and RF suitable high Q RF variable Johanson capacitors in my construction.

I don't have a pile of the very small units used in the 3456 filter; try using a brass screw and experiment with the size, starting with a 4/40 (which I used at 5760 MHz). For 3456 MHz maybe a 10/32 brass screw, or even a 8/32, would be suitable. I don't know, but for us the 4/40 was just the ticket at 5760 MHz. Give it a try. Experimentation is what amateur radio is all about. **Photo B** shows the side perspective of the

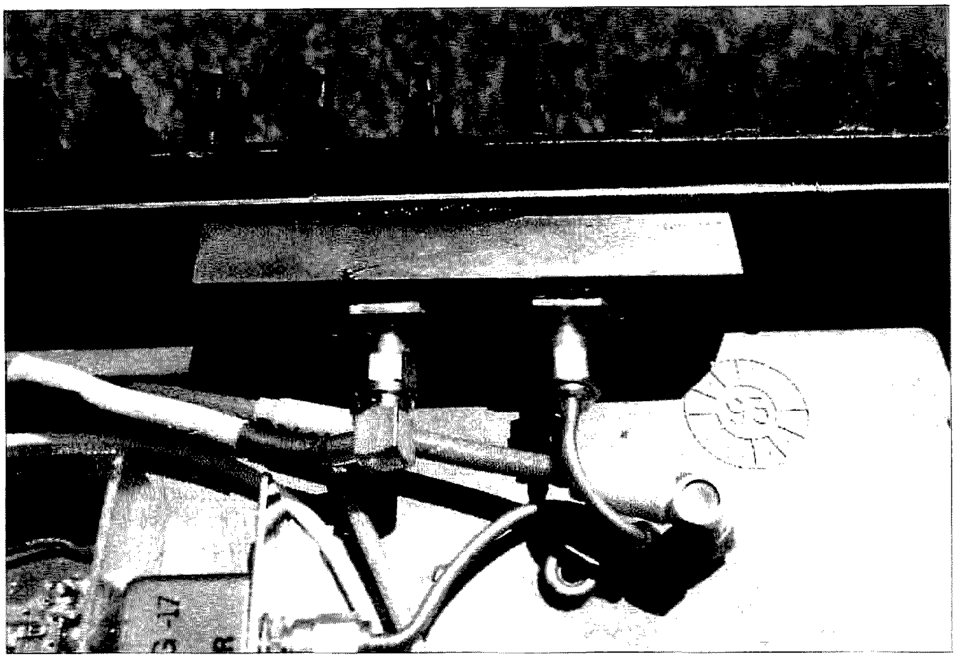
Photo C. Filter to be used at 3456 MHz.

filter constructed for 5760 MHz. You get a good view of the center pin going through the waveguide and soldered to the far end section of it.

This type of filter construction is typical, with little change other than using a variable capacitor for the lower frequencies and a brass screw for higher frequencies. The brass screw is still a capacitor in effect as it is setting a value of capacitance when the screw nears the bottom of the waveguide bottom. In this application, the value of the screw is something near 1 pF of capacitance. It might look like a screw but it is a capacitor in effect. I will probably get letters correcting me on that point but this was the easy tack to take, in describing why a screw can replace a capacitor.

Photo C is a close-up of a filter used in a 3456 MHz transverter that I constructed. The goop on top of the filter is a blue silicone RTV automotive gasket material. I used it to hold the filter in place on my cabinet side wall to prevent the filter from rattling around. Using RTV allows easy removal and replacement of material that doesn't require grounding. If at a later time an improvement is incorporated, changes can be made very easily by removing the RTV and rearranging components, as mounting holes and nuts and bolts are not required.

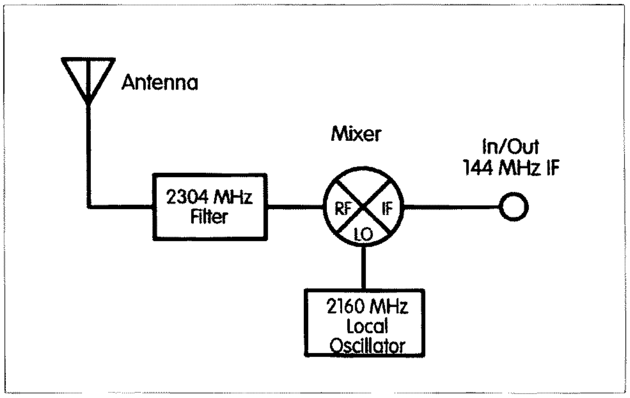

Fig. 1. Basic minimum RF transceiver using a local oscillator mixer and an RF filter. The simplicity of this arrangement allows operation without using coaxial relays. It is a "Peanut Whistle" low power rig, but works quite well.

Transceiver construction

Now for constructing the main transceiver. What does it take to construct a simple transceiver? Well, after you select an IF frequency that determines your local oscillator frequency to operate on a specific frequency, all you need is some coaxial switching and a mixer to function. Of course, this is a very basic system, the minimum needed to communicate. See **Fig. 1** for a diagram of this basic system.

A local oscillator, a mixer, an IF transceiver (2 meter in my case), coaxial relay switching, and a filter to prevent out-of-band RF radiation are all that is required. Improvements can include a receive preamplifier and a transmitter amplifier to beef up the mixer output level. When the basic system uses a mixer and just a filter, the antenna is a direct connection to the mixer, and is bidirectional. This system does not require coaxial switching due to this bidirectional connection. When any amplification is inserted in this path it directionalizes the path and requires coaxial switching.

Depending on your selection of RF amplification, there could be two different types of coaxial switching scenarios. The first and most common arrangement uses an individual receive RF preamp and a separate transmit amplifier. This most familiar, common arrangement of amplifiers requires two single-pole double-throw coaxial relays (SPDT) to accomplish RF switching. See **Fig. 2** for this RF switching configuration.

The other amplifier scenario is accomplished with a single RF amplifier serving both functions as an RF preamplifier for receive and an RF amplifier for transmit. This might seem a little unusual—using a single amplifier for a dual purpose—but it works well in low power systems. The RF switching trick to pull this arrangement off is to use an RF transfer relay. This type of relay is quite different from the SPDT used in the example described above.

"It might look like a screw but it is a capacitor in effect."

What makes a transfer relay special is that it has four connections for the RF switching path, with two connectors tied to each other at any one time. When it is operated, it reverses its path connection and makes contact to the other two connections, "transferring" the input and output connections. See **Fig. 3** for a diagram of a transfer switching configuration.

When you use a transfer coaxial configuration, the RF amplifier is tied between two fixed poles of the transfer relay. One of the other poles (coaxial connectors) that are vacant is tied onto the mixer RF port; the other is tied to the antenna. Which switching state the transfer relay is currently in depends on where you left the transfer relay

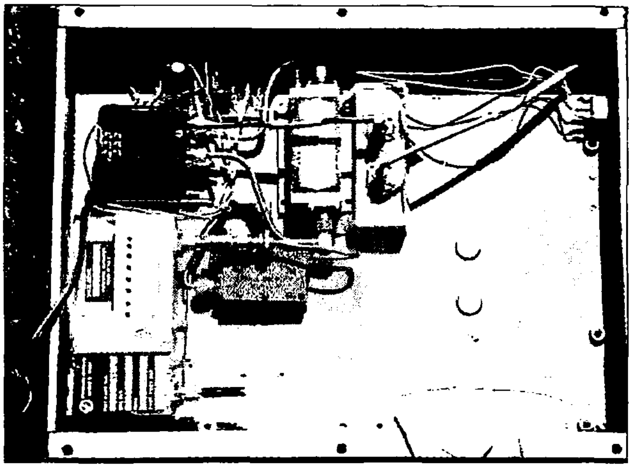

Photo D. Full view of the completed 3456 MHz transceiver/converter.

switching state. This relay is not a typical normally-open or normally-closed contact arrangement, but rather a latching relay. With a latching relay, it's a teeter-totter type of switch. It takes a DC voltage applied to a specific contact to change the switch direction. As the switch is operating it also opens the DC control voltage to the appropriate relay coil.

To transfer back to the original state (let's call it the receive state), you must apply a DC voltage to the other relay coil. Again, only a short pulse of DC is required as it also opens in this teeter-totter fashion. The point to note is that there are two relays in a transfer relay and they only use a momentary DC current to switch. This means quite a current savings from the battery operation point of view.

An SPDT coaxial relay requires current all the time that you want it to remain switched. To confuse the point, most SPDT relays are of this type but they can exist in a momentary relay function. In either case, the SPDT relay can be either momentary or continuous. From an operational point of view, the switching is the same with either relay.

Choose your relay with care, making sure it will function at the frequency you want to use. Almost all SMA type miniature relays that I have come across will handle modest power in the 10 watt range, up to and including 10 GHz, with little problem. An ohmmeter test for operation might show good results, but a loss test at the RF frequency you intended to use will show if it is usable or not.

Well, there you have some of the considerations that we have used to construct our transceivers. None of these units is a real powerhouse transceiver, but they do function and have all made contacts that were quite respectable. I hope that they show you that these rigs are not too cumbersome to construct, and that they can be repeated with other types of components that you might have on hand. That's the main thrust: Construct a rig for your frequency and put it on the air.

Sure, I could sell you something just like all the other supply houses, even though I work out of my home. However, my venture into amateur electronics is for fun and enjoyment, and, hopefully, to help you get something off the ground and on the air. I can't say it enough: Use your junk box, and always keep an eye out for new items to add to it. A well-stocked junk box will help you hold down costs on projects.

Letters and comments

Just one for the road this month: From time to time I am asked to design some big project gratis. In some cases this involves some basic idea with which someone wants help. Some have far-reaching implications, as in the case of (no names here) who wanted me to design a "worst-case engineering nightmare type of radar for aircraft collision avoidance." Well, I assigned that request to the round file for obvious reasons and liability questions. Recently, however, a friend gave me the solution to the design problem. I thought it worth repeating.

The solution to the worst-case radar aircraft avoidance system is as follows: "You should have pointed (him) towards new optical passive laser technology. A non-coherent diffuse electromagnetic wave source in the terrahertz region. This is used, together with a detector connected to a neural network, to determine the presence of objects. Triangulation from two detectors is used to estimate distance."

So simply put and with flair. I love it!

Well, that's it for this month. I will continue on the quest for converters for our microwave region, and stay with simplicity as best as I can. Best 73 Chuck WB6IGP clhough@aol.com (soon to change to Pacific Bell Internet Services).

Turn page for ***Fig. 3.***

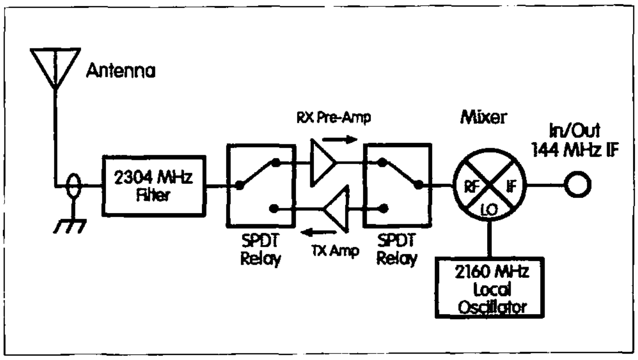

Fig. 2. RF coaxial switching using individual RF receive preamplifiers and separate RF power amplifier devices.

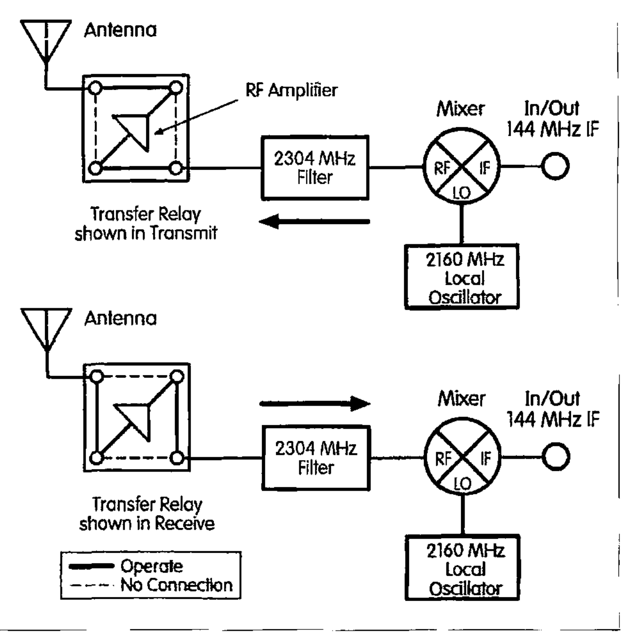

Fig. 3. Switching system using a transfer relay and a single RF amplifier, used for receive and low power transmit applications. This is the next step up from the basic mixer-filter-only approach in microwave transverters.

NEVER SAY DIE

Continued from page 55

their business incubator program, which won the prize as the best in the country for 1995. But I couldn't fight the total domination of the faculty's prestige game. I didn't want titles and battle ribbons to wear. I wanted results. Well, I got a few, but just a fraction of what I'd hoped for.

Then there was my adventure with the trustees of Central New England College, where as a consultant I tried to help them reorganize before it was too late. The faculty fought every inch of the way, and won. The result was that the college folded and everyone lost.

It was a similar story at Hawthorne College, only this time it was the students who called me as a consultant to try and save their college. Heck, I came close to buying the college just so I could make it into a model of what a college could be, with zero tuition and no government support. But the entrenched faculty prestige mindset, supported firmly by the accreditation bureaucracy, made me back off. The college folded.

Universities should make a fundamental decision. Are they going to be R&D laboratories, or teaching institutions? The two haven't mixed successfully yet. Their goals are just too far apart.

I went to college because that was what anyone who could afford it was supposed to do and I didn't know any better. I almost totally wasted four years. That was 50 years ago, when colleges weren't as bad as they are today, and I'm still grumbling. It's interesting that few successful entrepreneurs (according to an *Inc.* magazine survey) bothered to go to or finish college, thus putting themselves a few years ahead of college grads in the workplace. Well, you can get more details on my philosophy for making money in my $5 booklet on *Making Money, A Beginner's Guide*. Is Bill Gates a college grad? Steve Jobs? Just to name two billionaires that I happen to know personally. You bet they're not.

Rock

Amateur radio, in addition to providing my life with adventure, has also helped me get work—which can (and should) also be an adventure. In this case it was Graham Claytor W2MYL, one of my fellow RTTY pioneers

Continued on page 79

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Cold Fusion. Look, you ignored my blandishments to get involved with repeaters, which would have led you into getting rich via cellular telephones. Then you ignored my pleas to get involved with personal computers. So you're not a Bill Gates, Paul Allen, or Steve Jobs. You can't say I didn't try. The next biggie is going to be cold fusion. You can get an Overview report on the subject for $2 (order **CFO**) from Radio Bookshop. Or you can jump in and subscribe for 12 issues. The special *73* subscriber rate is $75 instead of $98. Warning, some of the articles are technical, some are on experimental systems. Order **CF-sub** from Radio Bookshop. Motorola and Bechtel are already jumping in on this new technology, yet the leading American researcher in the field had his lab in his garage and had less than $5,000 invested. He's now working for Clean Energy Technology Inc. (CETI).

The Book List by Wayne Green. This is a list of 83 books that I say you are absolutely crazy if you don't read. And none of this "I don't have time to read" crapola. These books are the best books I've found in a whole bunch of fields. Many were recommended by readers as being top notch. It's time to become educated on health matters, our school system, our corrupt government, history, science, communicating with plants and animals, child development, the occult, and so on. Order **BL** $5 from Radio Bookshop.

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The Junk Box Power Supply

A short course on power supplies.

Don Crowder N5TWH
Central Texas C & E
P.O. Box 349
Kingsland TX 78639

Every time you turn around these days, it seems you need a power supply. The kids have dozens of electronic toys and we adults have more than a few of our own that use lots of expensive batteries. All these gadgets seem to have jacks on them for external power, but the little wall transformer type power supplies are expensive in their own right. Luckily, most of us have junk boxes full of transformers, diodes, capacitors, and transistors. The experimenters' books and magazines are full of power supply circuits but most of them are built around one or another integrated circuit. Granted, these are excellent circuits, but "chips" have lots of legs, they cost more, take more time to assemble and test, and you never have the right chip in your junk box anyway.

Well, here's a nice, simple, discrete transistorized regulator that's usable between 3 and 24 volts and which can be assembled in a couple of hours or less. Since none of the component specifications or values are critical, you probably already have the parts. There's more here, however, than a neat, easy power supply. This is a pretty good short course on power supplies in general, and you may even learn a trick or two.

The transistors

The whole electronics industry uses NTE numbers for replacement transistors so these numbers are shown (see **Fig. 1**), but you can look up the number of the transistor you happen to have and, if it crosses to the NTE number, it's usable (that's called a back-cross). If you don't have a cross reference book, then call your local parts distributor and beg.

The zener diode

The zener value should be 2 volts larger than the desired output voltage. Zener values can be increased, in increments of .6 volts, by placing them in series with ordinary diodes (like the 1N4000 series) installed in opposite polarity. For example, where an output of 9 volts is desired, requiring an 11 volt zener, let's say that all you can find in the junk box is a 9.1 volt zener. You can add three ordinary silicon diodes to get a value of 10.9 volts, which ought to be close enough to serve. The zener's power rating is unimportant (see **Fig. 2**).

The transformer

Even serious technicians can't always figure out which of the odd transformers, in that box out in the garage, are suitable for a given voltage and current requirement, hut with some common sense and practical knowledge, you can make a fairly close "guesstimate."

First, you need an old appliance cord (in good shape) with insulated clip leads on the end opposite the plug. Before

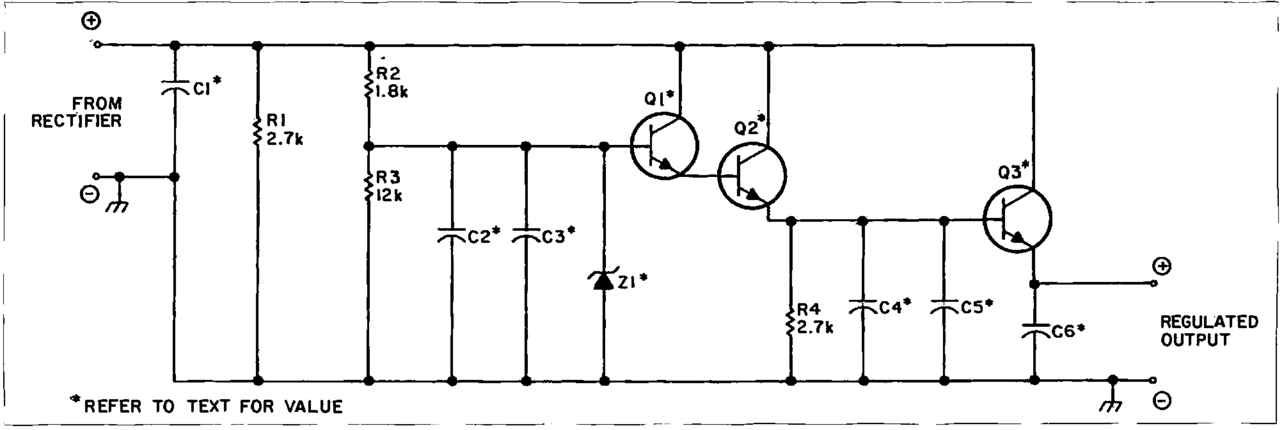

Fig. 1. Schematic diagram of the Junk Box Power Supply regulator circuitry.

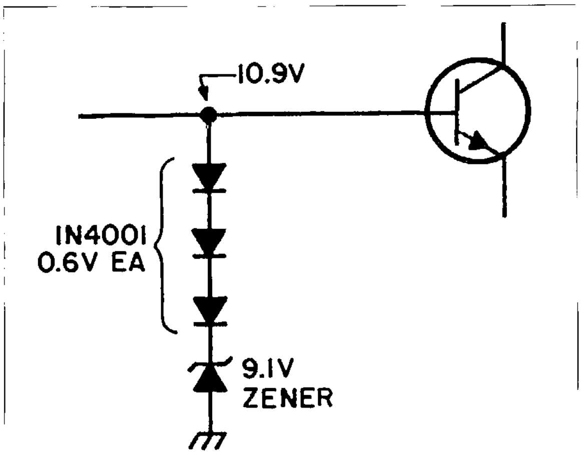

Fig. 2. The value of a zener diode can be easily increased by the addition of several ordinary rectifiers.

testing an unknown transformer, use an ohmmeter (R x 1) to determine which wires represent separate windings (by checking continuity) and note which windings exhibit resistance over 100 ohms. The windings with higher resistance can be safely treated as the primary ones. Secondary windings, in the voltage range we are seeking, normally exhibit very low DC resistance (on the order of 2 to 20 ohms). If possible, it's best to avoid transformers with multiple windings. Unused windings are not esthetically pleasing, cause confusion, and generally make a person nervous.

Testing the transformer

Before plugging it in, connect the power cord to the primary and a meter to the secondary (set for AC volts and, initially, a scale around 100 volts). Plug in the cord, adjust your meter scale, and make a note of the AC voltage, then *(safety first)* immediately unplug the cord. Your "garden variety" multimeter, analog or digital, reads RMS voltage. The filtered raw DC obtained from this transformer, assuming the use of a single diode (half-wave rectifier) or a bridge rectifier, will be 1.414 times the measured AC voltage. In the case of a full-wave rectifier, the filtered raw DC is reduced by half. For example, a 12.6 volt (AC) transformer feeding a half-wave or bridge rectifier will yield 12.6 x 1.414, or about 17.8 volts DC at the filter capacitor where a center tapped 12.6 volt AC transformer feeding full-wave rectifiers will yield 17.8 / 2, or about 8.9 volts DC at the filter capacitor (see **Fig. 3**).

"This is a pretty good short course on power supplies in general, and you may even learn a trick or two."

As a rule, the filtered raw DC should be close to twice the desired regulated output for optimum usable output current. The 17.9 volt raw DC in the preceding example would be ideal for use in a 9 VDC regulator, but usable at 6 VDC, with increased heat generated in the circuit, or equally usable at 12 VDC with reduced output current capability. To estimate the current capability of a given transformer, get a large assortment of high-power resistors, hook an amp meter to the filtered output, and clip resistors across the circuit in whatever combination causes the raw DC to load to the desired regulated output voltage. The transformer's current rating is approximately 3 amps (regulated at half the raw DC value) and this method is linear (half the size of a fist ought to be good for around 1.5 amps; twice that size for around 6 amps) but it only applies to transformers with a single secondary. I know this method sounds silly, but a crusty old super-tech once decreed "Mess not with that which works." ("Mess" was *not* the word he used.) Thus was born Dirty John's Axiom, because of which hundreds of young fellas have been better off.)

Design and Construction

The type of rectifier diodes used is unimportant as long as their voltage and current ratings are sufficient for the circuit's needs. If a bridge rectifier is used, it isn't necessary to find a fancy single unit molded bridge assembly; scrounge up four suitable diodes and build your own. A fused output lead is advisable, with the fuse's ampere rating selected to be around twice the expected output load. This circuit is good for a maximum output current of around 5 amperes. To increase the current capability to 8 amperes, connect Q2 to a good heat sink and use two identical transistors in parallel for Q3. The output pass transistor, Q3, must be installed on a heat sink and have adequate ventilation. Installation, and subsequent servicing of Q3 can be made easier by using a

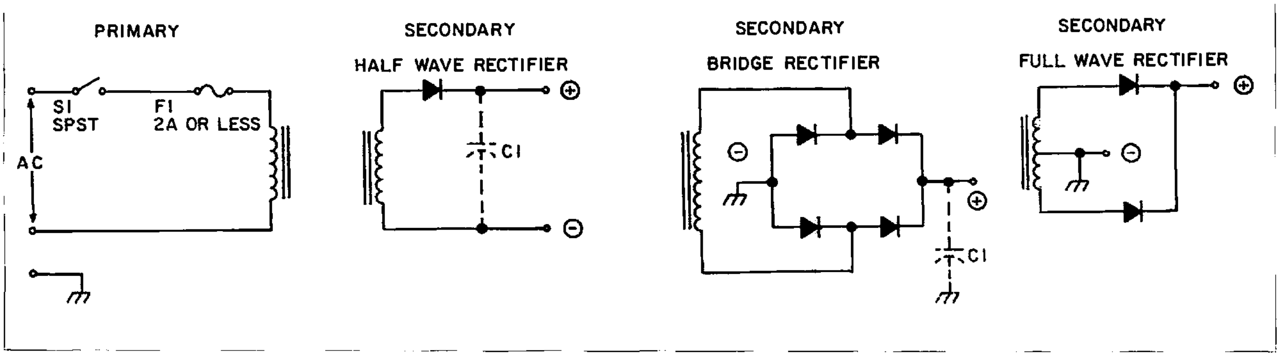

Fig. 3. The three possible configurations of rectifier circuit: Choose one based on the transformers and rectifiers you have available.

socket. If two output pass transistors are used, they can be effectively equalized by installing them three or four inches apart on the heat sink, bridging the emitters with a six-inch piece of solid #16 or #14 bare copper wire, and making the emitter connection, from Q2, to the exact center of this solid wire (this can also be done for the collectors but take care to locate the wires well clear of one another). Quick and easy access to the output can be accomplished by using the two-pin quick disconnects, found in auto parts, hardware, and big variety stores. Remember that the insulated positive lead goes on the supply; the uninsulated positive lead goes on the jumper for whatever gadget you're powering (see **Fig. 4**). This configuration prevents an uninsulated live contact from coming in contact with ground.

If you don't have a single large electrolytic suitable for the filter capacitor (C1) you can use several smaller values, since capacitors in parallel are additive, to build up the desired value. Resistor R1 is a bleeder resistor that serves to discharge the filter capacitor when the circuit is turned off and should be rated for at least a half watt, but the other resistors in the circuit can all be quarter-watt.

Parts List

Q1: 2N2222A (NTE 123)
Q2: 2N5296 (NTE 152)
Q3: 2N3055 (NTE 130)

Capacitors

C1: Electrolytic; 10,000 microfarads, or larger, rated for at least twice the raw DC voltage.
C3 and C5: Electrolytic; minimum 100 to 500 microfarads, rated for at least twice the desired regulated voltage.
C2, C4, and C6: Non–polar, ceramic, Mylar™, or polyester; .005 to .1 microfarads, rated for at least 50 volts or better.
Zener diode

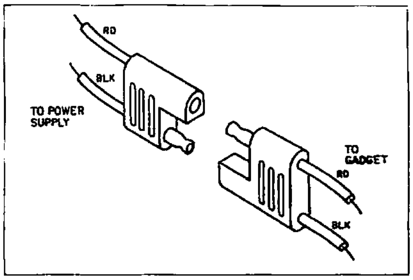

Fig. 4. The proper configuration of the two-pin quick-disconnect connector.

If current demand below 500 mA is required, simply reduce capacitor values by one third and use 2N2222As for all three transistors.

Remember, the batteries you save will feel like money in your pocket, not to mention that you'll use up some of that stuff you've been hoarding in your junk box for the last decade or two, and (here you must imagine a string orchestra playing something stirringly patriotic) on account of those unused batteries not going into a landfill, you'll be helping promote a cleaner planet as well as a better way of life for America. (Truth, justice, and the Hamerican way.)

NEVER SAY DIE

Continued from page 76

and the vice president of Pacific Gas and Electric, who got me a great job. The president of the company's wife needed a general manager for her Music Research Foundation. My background in both music and as a professional psychotherapist clinched the deal.

One of my responsibilities was to organize and run monthly meetings which were attended by some of the top psychiatrists, psychoanalysts, and psychologists in the New York City area. At these meetings these professionals discussed the research that had been done on the use of music in psychotherapy.

The end result of this was that I wrote a book which the Foundation proudly published, *Music and Your Moods*. My first book!

Now, let's leap to 1996, understanding that I have a pretty good background in both music and psychiatry, and a recent scientific report that made a lot of sense to me. You're aware that our bodies have a number of sympathetic frequencies that are used during biofeedback. Well, it turns out (surprise!) that our bodies (minds) also are sensitive to rhythms.

In experiments done on both rats and people, classical music has enhanced learning. Rats, for instance, exposed to classical music learned to figure out and remember mazes 43% better than a control group. Another group, exposed to rock music, came in at 85% below the control group. Which may help to explain the phenomenal increase in attention deficit disorder in children in the last couple generations.

If you've read Chris Bird's *Secrets of the Soil*, like I asked you to (it's on my list of books you're crazy if you don't read), you know that farmers who play music for their crops get larger, better lasting crops and have fewer problems with pests. Classical music, that is. When rock 'n' roll is played the plants are stunted and the fruits and vegetables of much poorer quality.

Well, I'm glad to see scientific, controlled tests agree with my intuition. For some reason I've always liked classical music and disliked rock. That's probably what's responsible for my attention surplus disorder. No, we never had any classical music around the house when I was young. My first exposure was

Continued on page 87

I Built It Myself!

An easy weekend project—build a variable-voltage power supply.

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Although most of us have a couple of 12-volt power supplies around, they usually wind up being dedicated to permanent duty. Most of us need a power source with fairly good voltage regulation for projects we're working on, and I frequently need some odd voltage like 5 or 9 volts. So I built a supply that provides DC voltages between 3V and 16V at up to 5A, and it's small and light enough to be portable. It's turned out to be a very handy supply for general bench use.

The circuit

I used an LM317T three-terminal adjustable voltage regulator to control a power transistor that regulates the output voltage level. It's a simple circuit, but quite effective in providing a stable output voltage over a wide current range. The LM317T is capable of handling up to 1.5A by itself. By adding a power transistor, the current regulating capability of the circuit is effectively multiplied severalfold. In this case, with a 2N3055, this regulator circuit can safely handle up to 10A (the maximum rated collector current for a 2N3055 is typically 15A). The circuit is shown in **Fig.1**.

"A defunct piece of consumer electronics might be an excellent source."

The maximum current a supply like this can deliver is mainly limited by the transformer. I used one rated for 25V at 4A continuous duty because I had it lying around. Any available transformer with a secondary winding of 18 to 25 VAC at 2 or more amps will work. A defunct piece of consumer electronics (e.g., a VCR or old transistor TV) might be an excellent source. Obviously, the voltage and current capabilities of the supply will depend on the transformer you have available.

I used a 10k, 10-turn pot for voltage control because I happened to have one, but any 5k to 15k pot will work.

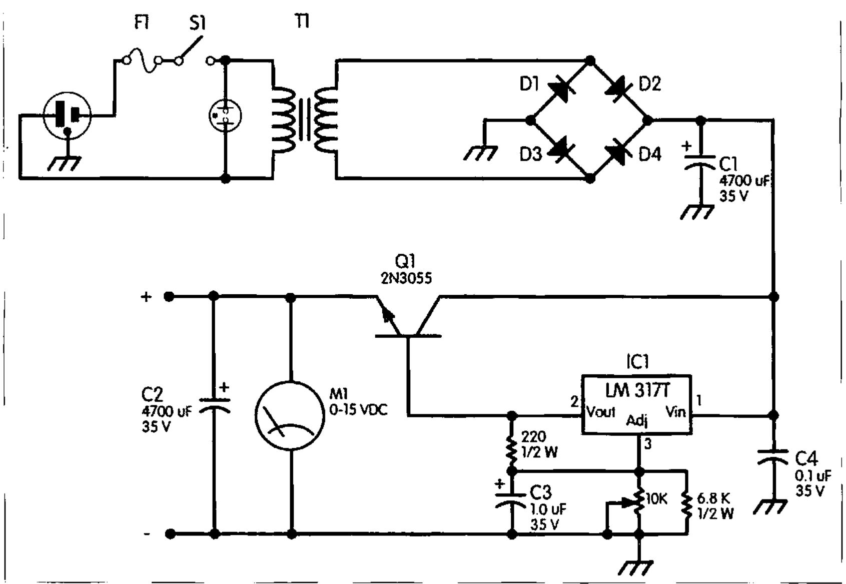

Fig. 1. The variable voltage utility power supply circuit.

Pots, together with dials similar to the one I used, turn up frequently at flea markets. I wanted to limit the variable range of my supply to be within the range of the meter I used, a 15V job, so I added a half-watt 6.8k resistor in parallel with the pot to get the desired adjustable range. You can experiment with this resistor's value to tailor the range you want. The meter is a stock item at Mouser™, but any meter can be made to work.

The remainder of the circuit is fairly conventional. I used discrete rectifier diodes in a bridge circuit, but a full-wave bridge rectifier assembly, such as the Mouser unit, could also be used, so long as you select one with adequate current and voltage ratings. The filter circuit comprises two 4,700 µF capacitors, one at the bridge and the other at the output. It provides a respectively low ripple output. If you need a supply with even lower ripple, add more capacitance.

The application notes on the LM317T advise adding a 0.1 µF bypass capacitor at V_{in}, and 1.0 µF at V_{out} (pins 1 and 2, respectively). I used 35W VDC tantalum capacitors for this; however, these are

not essential. They provide for general circuit stability and good transient response characteristics—traits I wanted for my supply. The application notes also show a nominal 240-ohm value for the resistor between pins 2 and 3 of the regulator IC, but I've found a standard 220-ohm resistor works fine.

Construction

The enclosure shown in **Photos A** and **B** is one marketed by Radio Shack™, but an adequate one can also be ordered through Mouser (#563-CU-3011A, for example).

The layout is up to you. I wanted binding posts on the front panel, but you may prefer them on the rear. Again, Mouser stocks several types of binding posts, and I've seen them at flea markets.

The regulator and power transistor should be mounted on some kind of heat sink. Also, if you use a bridge rectifier assembly, it may require heat-sinking too. I used an "L" bracket, made from a piece of scrap aluminum, visible in **Photo B**. This has proven just fine where the average current runs 2 to 3 amps. You might want to use a standard heat sink if you intend to run higher average currents for extended periods. This could be mounted on the rear panel. Heat sinks and mounting hardware kits, including mica insulators, etc., are stocked by Mouser.

I included a rear-panel fuse holder and a front-panel pilot lamp and power switch as accessories, and used a three-wire grounded AC line cord. These items are definitely "junk box" parts—use whatever you have on hand. Just make sure the lamp voltage and switch current ratings are correct for this circuit. The wiring is essentially point-to-point, using a couple of five-lug tie points to mount the small components associated with the regulator circuit. I soldered connections directly to the regulator and transistor by bending their pins into lugs with needle-nosed pliers. After completing the wiring, I used a couple of tie-wraps to neaten the job.

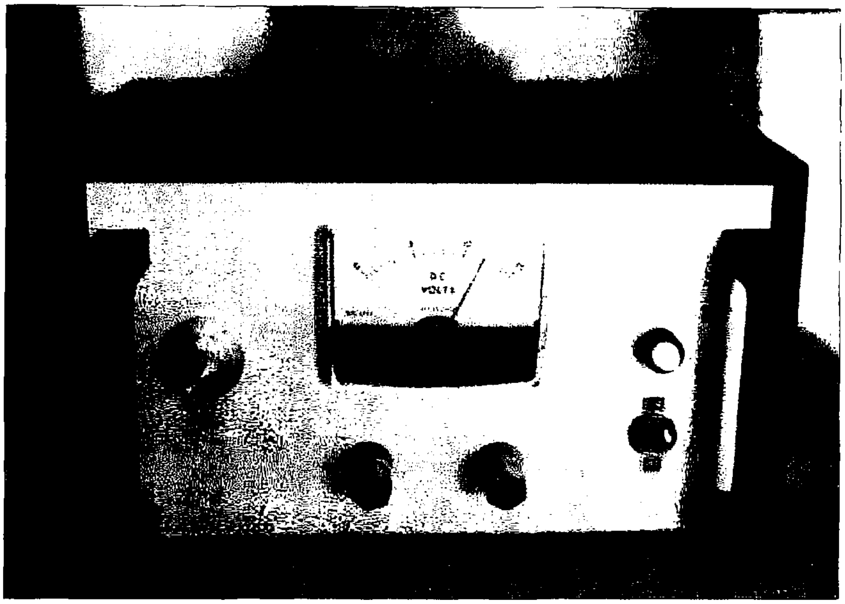

Photo A. K8KWD's variable-voltage utility power supply.

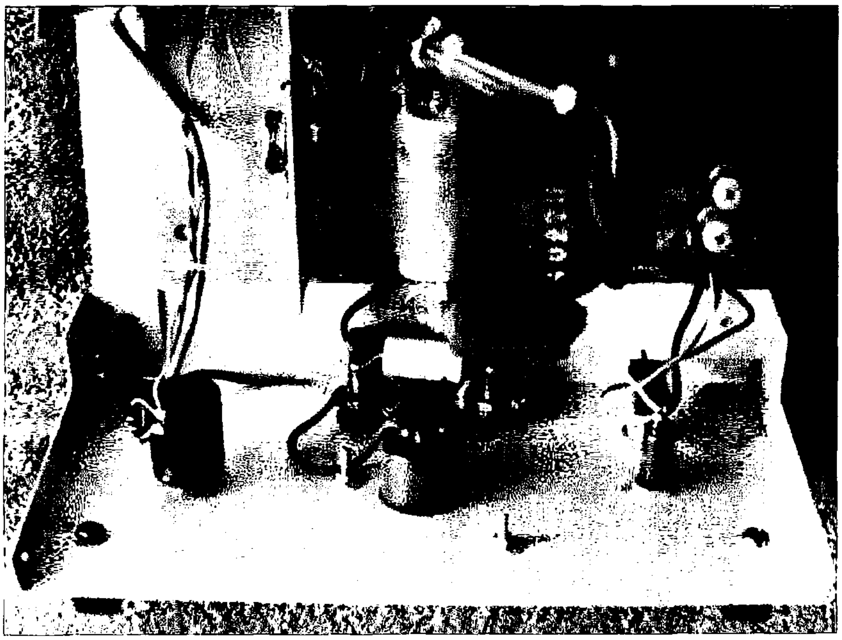

Photo B. Interior view of the power supply, showing construction details.

Operation

I've used this supply for a variety of things, such as a battery charger and a temporary power supply for a 2 meter rig. I mainly use it as a test supply when I'm building something new. It's handy because I frequently need 5, 9, or 12 volts, etc., and I simply dial it in.

Parts List

T1	Power transformer, 120 VAC pri., 24 VAC @ 4A sec. (Mouser 553-F8-24)
M1	0-15 VDC voltmeter (Mouser 39TM601, or equivalent)
Q1	2N3055 (Mouser 511-2N3055)
IC1	LM317T (Mouser 511-LM317T)
D1-4	Rectifier, 6A @ 50 PIV (Mouser 583-BR605)
C1-2	4700 µF @ 35 VDC (Mouser 539-SKR35V4700)
C3	1 µF @ 35 VDC tantalum (Mouser 539-SKR50V1.0)
C4	0.1 µF @ 35 VDC tantalum (Radio Shack 272-1432)
F1, S1	Lamp, as available

Number 82 on your Feedback card

Ask Kaboom

Your Tech Answer Man

Michael J. Geier KB1UM
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Peterborough NH 03458

Still stressed out!

Last time, we were examining the effects of the three kinds of stress that damage electronic gear: mechanical, electrical and thermal. This time, let's take a look at the components themselves and how the three stresses affect each one.

Semiconductors

Mechanical stress is rarely a factor in semiconductor failure. You can throw a transistor or an integrated circuit across the room all you want, and it'll still work. That wasn't always the case, though. Early point-contact devices and germanium parts were mechanically fragile, but that era ended around 30 years ago. Today's parts are quite hardy. You pretty much have to crush modern semiconductors to kill them.

Electrical stress is another matter! While bipolar transistors will stand plenty of abuse, overvoltage can punch holes through their junctions, shorting them out. All semiconductors exhibit this failure mode, but CMOS and FET parts are much more susceptible to it than are bipolars. Typically, "overvoltage" situations occur when inductance is involved, such as with tuned circuits leading to antennas in the output stages of radio transmitters; that's why SWR is a problem for solid-state output stages. Another common culprit is a transformer or other coil in a switching power supply. The reason inductance causes trouble is that it can transform current into voltage. The result is that voltages can be present which are actually higher than the power supply voltage used to generate the signals, and those voltages may not be entirely predictable, as in the SWR example above.

Pulling a lot of power through semiconductors doesn't directly destroy them, but the resulting heat sure can. Probably more semiconductors are blown by their own heat than by anything else. Of course, small-signal stages don't make significant heat (at least unless something goes seriously wrong), because the currents involved are quite small; so, at today's low circuit voltages, the resulting power in watts is very tiny, typically in the milliwatts. Output stages and power supply circuits, though, can make quite a bit of heat. Why do semiconductors get hot? It comes down to resistance and efficiency: all semis have some resistance (as does anything besides a superconductor), so none is completely efficient. The product of inefficiency is heat. Analog circuits, in which the active elements are often in their linear regions (somewhere between fully on and fully off), are the least efficient, because the semiconductor is acting as a variable resistor. Digital circuits, which turn on fully saturated (as far as they can go), are considerably more efficient, but even they produce their share of heat. That's why heat sinks are both important and common, and why today's big microprocessors often have those little fans on top of them.

> **"You can throw a transistor or an integrated circuit across the room all you want, and it'll still work."**

Externally generated thermal stresses are rarely a problem for semiconductors. I suppose it's possible for one transistor to generate enough heat to damage another one mounted on the same heat sink, but it certainly isn't likely. With semiconductors, most thermal problems result from internal heating.

When semiconductors fail, they can become either open or shorted. Many open parts end up that way after being momentarily internally shorted; the resulting "overcurrent" then overheats the part and opens the junctions. That's why you may find an open transistor and a blown fuse at the same time!

Resistors

Mechanical stress sometimes fractures power resistors, especially when they're hot, but resistors are generally hard to break. They can be easily snapped when bent, though, as they are rigid and brittle, much like glass or clay. So, if you sit on your HT, expect some broken resistors. (Of course, the PC board will probably be so far gone that it won't matter.)

Pulling too much power through a resistor is the easiest, and most common, way to destroy it. In tube gear, resistors actually used to catch on fire now and then, but that's pretty rare today. More likely, a resistor killed by an over-power situation will show some blackening, and it may even be cracked in half, but it won't be burned to a crisp.

It's important to remember that resistors are supposed to generate heat; that's the natural product of resisting current flow. Of course, it's not the heat we want, it's the resistance itself, because it limits current flow or reduces voltage. But, we can't escape the heat. That's why resistors are rated in watts; the heat generated is directly proportional to the power (in watts) going through the resistor.

Resistors are not active elements, so they don't cause their own demises, at least not very often. In the vast majority of cases, a failed resistor means something else has gone, too, causing a short circuit that pulls excessive power through the resistor. That's an important clue to remember when you're servicing a circuit and come across a burned or opened resistor (they virtually never fail shorted). Look for the connected semiconductor and check it out; either it or something driving it will be shorted.

Capacitors

There are so many kinds of capacitors that it's hard to classify them all as the same parts! The major kinds, including electrolytic, ceramic and plastic, have different characteristics, both in operation and failure.

> **"Caps shouldn't get hot!"**

Electrolytic capacitors, including tantalums, use a thin oxide layer to electrically separate the two sides. That layer gives them properties similar to those of semiconductors, particularly where mechanical and electrical stresses are concerned. It's pretty hard to physically damage an electrolytic cap unless you step on it, but a voltage significantly higher than the part's rating will punch holes through the oxide and short out the part. Plenty of electrolytics die from "overvoltage". But, don't manufacturers take the voltage rating into account when the circuits are designed? Of course they do, but some circuits exhibit voltage variations that exceed the caps' ratings. Also, failure of another part can subject a capacitor to voltages not anticipated by the circuit designer. For example, if a 5-volt regulator shorts out and feeds 12 volts to a circuit intended for 5 volts, some 6-volt tantalum caps may get blown in a hurry. In my experience, regular aluminum electrolytics are quite a bit more tolerant of short-term overvoltages than are tantalums; those little things short out very easily. I've seen plenty of shorted tantalums, even in circuits where the voltages never exceeded the caps' ratings. I consider tantalum caps to be among the least reliable parts in our products. Why use them? They offer lots of capacitance in a small package, are closer to their rated capacitance than aluminum caps, and are stable over time. I still don't like the things, simply because they short out so often.

Internal heating of an electrolytic capacitor indicates a problem, except in very rare circumstances. Basically, caps shouldn't get hot! When one does, it's probably getting ready to die. I've seen some

electrolytics in switching power supplies that got noticeably warm in normal operation, but even they didn't get hot. Usually, a hot cap means it's leaking, so it's acting like a resistor. If you see a hot cap, change it, unless you're sure it should be that way.

Externally generated heat can kill electrolytics, though, mostly through drying the electrolyte out of them over a period of years. I've seen some whose capacitance slowly went down until the cap couldn't do its job, because it was basically an open circuit. The heat of tubes used to do that to electrolytics all the time, and the caps were made out of paper in those days, making the problem even worse. With today's sealed aluminum parts and cool circuits, it shouldn't happen, but it still does now and then. The dried-out caps I've seen have all been near heat sinks that got very hot in normal operation, like you might find in the output stages of RF and audio power amplifiers. A smart designer will keep the caps away from the heat sinks.

Ceramic caps are among the most reliable parts in existence. They can be shattered by strong force, but, unless you bend one, you won't break it. And, unless something has exceeded their voltage ratings, you'll probably never see a bad one. I've only seen two, I think, in all the years I've been in electronics! The basic design is pretty foolproof: two plates separated by a ceramic insulator. It doesn't take much thickness for the ceramic to withstand pretty high voltages. Still, some small ceramic caps are rated at around only 50 volts, which isn't all that high. I've never seen a shorted ceramic part, and the two open ones I've run into have both had mechanical failures where the leads connected to the plates.

As with all caps, internal heating should not occur. Some ceramic caps used to be coated with a wax-like substance which would bubble if the cap got hot. Modern caps don't use the stuff. External heat could damage a ceramic cap, I suppose, but I haven't seen it happen. The things are pretty indestructible.

Well, I think we've covered enough for one column, so we'll continue this next time. Until then, 73 de KB1UM.

Number 73 on your Feedback card

HAM HELP

We are happy to provide Ham Help free on a space-available basis. To make our job easier and to ensure that your listing is correct, please type or print your request clearly, double-spaced, on a full 8-1/2" x 11" sheet of paper. Use upper- and lower-case letters where appropriate. Also, print numbers carefully. A 1, for example, can be misread as the letters I, i, l, or even the number 7. Specifically mention that your message is for the Ham Help Column. Please remember to acknowledge responses to your requests. Thank you for your cooperation.

WANTED: Manual and schematic for an RCA 8-channel, 3-band crystal scanner, model 16S300. Please contact *Glenn Torres KB5AYO, 584 Central Ave., Reserve LA 70084.*

WANTED: Manual for KENWOOD 2m TR-2500 HT. I'm particularly interested in programming instructions. Also, I need connection instructions to install an SS-32 S MP CTCSS Tone Encoder Board. Will pay all costs. *Ron Zemljak N7LDQ, 140 Maude S Canyon, Butte MT 59701. Tel. (406) 494-5453.* Thanks.

I need schematics for HEATHKIT SB300 and SB400. Also a partial manual for Model SB313. *Robert Schlegel N7BH, 2302 286 Street East, Roy WA 98580.*

NEEDED: Manual/schematic and help for ROBOT SSTV Camera and Monitor 70. Also, is anyone out there using an AMIGA Computer with their ham radio? *Tony Bodo WA9YOZ, 4623 E. 25th Ave., Lake Station IN 46405.*

WANTED: A copy of the tube data test chart for a MERCURY Model 1101 Tube Tester. I will gladly pay for the info. Thanks. *Bill Axsom K4GDI, 2098 E 500 N, Rushville IN 46173.*

Number 83 on your Feedback card

HAMSATS

Amateur Radio Via Satellites

Andy MacAllister WA5ZIB
14714 Knights Way Drive
Houston TX 77083

New Fuji in orbit

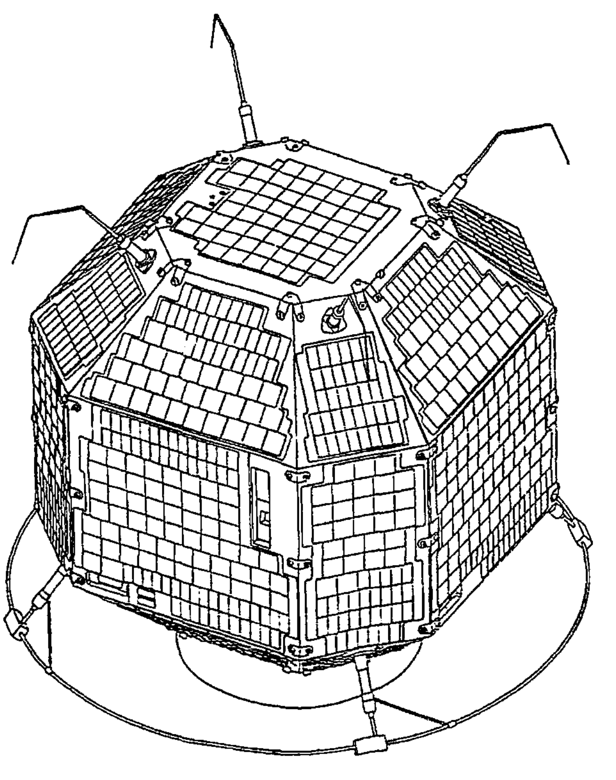
On Saturday, August 17, 1996, Fuji-OSCAR-29 was sent into orbit from the Tanegashima Space Center in southern Japan. Our newest Orbiting Satellite Carrying Amateur Radio was launched on a Japanese H-II rocket with the Advanced Earth Observing Satellite (ADEOS) by NASDA (Japan's National Development Agency). F-O-29 is performing well. It has both digital and analog Mode "J" transponders and promises to be an exciting addition to the hamsat fleet.

The rocket

NASDA has been in the space business since 1975. The latest and largest production launch vehicle is called the H-II, developed to meet the demands for large spacecraft of the 1990s. It is a two-stage vehicle capable of delivering a two-ton satellite to geostationary orbit.

The first H-II rocket was launched in early 1994 carrying the Orbital Re-entry Experiment (OREX) and other smaller payloads. Later that year the Engineering Test Satellite-VI (ETS-VI) was placed in orbit by the second H-II rocket. The third H-II test vehicle also carried multiple payloads and was launched in March 1995. One of the payloads, the Space Flyer Unit (SFU), operated as an orbital unmanned laboratory for various experiments. It was retrieved using the robot arm on the Space Shuttle Endeavour by astronaut/mission specialist Koichi Wakata.

Fuji-OSCAR-29 went to orbit on the fourth H-II vehicle. This version of the H-II included two Small Solid Boosters (SSB) on



the first stage to accommodate the payload weight and a large fairing around the satellites. The liquid-fuel rockets for both stages use liquid hydrogen and oxygen. The H-II launcher with payload stands around 150 feet, just a bit shorter than the Space Shuttle with external fuel tank.

ADEOS

The ADEOS satellite is the largest satellite Japan has ever developed, weighing approximately 3.5 tons. While the H-II rocket system can place two tons in geostationary orbit, it is also

JAS-2, FUJI-3, F-O-29

Prior to launch, the new Japanese hamsat was called JAS-2. After launch it became Fuji-3. Its two predecessors were called JAS-1A and JAS-1B before their launch, and Fuji-1 and Fuji-2 after launch. The addition of the "OSCAR" designation was made later. Project OSCAR in California built the first ham-radio satellite over 35 years ago. OSCAR-1 transmitted a simple CW beacon on 2 meters for a few weeks until re-entry. Fuji-OSCAR-29 has a complex array of computer systems and radio

"The H-II launcher with payload stands around 150 feet, just a bit shorter than the Space Shuttle."

capable of sending nearly four tons to this mission 's target orbit, 800-km high, and sun-synchronous. After full deployment, ADEOS, with its solar array, has a wingspan of nearly 100 feet. The main body, with antennas and sensors extended, is nearly 35 feet long and 22 feet thick.

The main objectives of ADEOS are to acquire global environmental data, develop and verify the operation of the Ocean Color and Temperature Scanner (OCTS) and the Advanced Visible and Near-Infrared Radiometer (AVNIR), and to demonstrate a recently developed inter-satellite data relay system. ADEOS has a design life of three years.

gear in its small frame, and should last several years. Fuji-OSCAR-20 has been in orbit for six years, and is still doing a great job, when properly illuminated.

F-O-29 has 26 sides, giving the basic octagonal shape a spherical look. It is about 20 inches wide and weighs just over 100 pounds. Most of the outside surfaces are covered with high-efficiency, gallium-arsenide solar cells. Thanks to these new solar cells on the large exterior surface area, F-O-29 has plenty of power available for the communication and command systems. Power generation is more than 22 watts at the beginning of life in orbit. F-O-20 had only 10 watts available, and F-O-12 only 6.5 watts. Enough power is available on F-O-29 to run all the experiments and computers simultaneously.

Attitude control is achieved using a sun sensor, geomagnetic sensor and magnetorquer, all under computer control. The goal is to spin the satellite at 10 rpm along the vertical axis, perpendicular to the orbital plane. This will keep the 2 meter, ring-shaped turnstile antenna continually aimed earthward. The four 70 cm whip antennas are located on the upper portion of the satellite structure.

The final polar orbit for F-O-29 has a perigee, or low point,

JA Uplink	145.900 to 146.000 MHz
JA Downlink	435.900 to 435.800 MHz
JA Beacon	435.795 MHz 100mW CW
JD Uplink	145.850, 145.870, 145.890, 145.910 Mhz AFSK (FM) 1200 bps AX.25 Manchester 9600 bps FSK on 145.870 MHz only
JD Downlink	435.910 MHz 1200 bps BPSK (SSB) AX.25 using PSK modem or 9600 bps FSK (FM) AX.25 using standard 9600 bps modem or "Digitalker " FM voice

Table 1. Band plan for Fuji-OSCAR-29

around 860 km. The apogee, or high point, is just over 1300 km. The slightly elliptical orbit can provide users with better low-earth- orbit DX opportunities during apogee times.

Communications

All uplinks are on 2 meters, with downlinks on 70 cm. This frequency combination is typically called Mode "J," in honor of the JAMSAT-built transponder that went into orbit on AMSAT-OSCAR-8 in 1978. Mode "J" has become the primary transponder configuration for many digital and analog amateur-radio satellites.

F-O-29 's digital package uses 1200 or 9600-baud AX.25 packet protocol, with four discrete 1200-baud, FSK (frequency-shift keying) uplink channels (145.85, 145.87, 145.89 and 145.91 MHz), and one PSK (phase-shift keying) channel for the downlink on 435.91 MHz. The 9600-baud FSK uplink is on 147.87 MHz. The corresponding 9600-baud FSK downlink is on 435.91

link passband (435.9 to 435.8 MHz). Most communications can be heard near the center of the downlink near 435.850 MHz. Typically, CW operation is below the center, while voice is used above center. The total transponder power output is 1 watt. A 100-mW CW beacon is associated with the analog transponder on 435.795.

An additional "Digitalker" system has been added to F-O-29. It will allow voice messages to be uploaded to the satellite for continuous repeating transmission on 435.91 MHz FM when the packet system is not active. The FM signal should be easily heard with only a hand-held scanner or HT.

More information

Additional data about the newest hamsat can be easily found on the Internet. The best source is from the Japanese Amateur Radio League. The URL (Universal Resource Locator) is: http://www.jarl.or.jp/jarl/jas-2/. Another good source of information can be found at the Southeast

"Thanks to the gallium-arsenide solar cells, F-O-29 has plenty of power available."

MHz, same as the 1200-baud PSK transmitter. The 1200-baud and 9600-baud speeds do not operate simultaneously, but are scheduled by the ground-control station.

The analog transponder is 100 kHz wide and inverting. A lower sideband signal transmitted by a ground station high in the transponder uplink passband (145.9 to 146 MHz) will be heard on upper sideband low in the down-

Michigan Area AMSAT Net web site: http://www/wwnet.com/~jsmyth/index.html. Don't forget the home page for the Radio Amateur Satellite Corporation. It's URL is: http://www.amsat.org. More information about NASDA, the Japanese version of NASA, can be found at: http://www/nasda.go.jp/. F-O-29 promises to be a lot of fun, in addition to being a valuable orbiting resource. 73

QRP

Low Power Operation

Michael Bryce WB8VGE
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Massillon OH 44646

Egad! It's November already. There may be just enough time to throw one more project together before the holidays.

Since time is rather short, I'll look at several easy-to-build kits. Many of these kits cost under fifty bucks. All of them can be assembled by beginners in a few hours. Experienced builders can be using the kits in less than half an hour.

The "easy" kits

Here is one for the rest of us. Designed by Wayne Burdick N6KR, it's about as simple as you can make a transceiver and still be able to make contacts with it. The rig is called the 49er.

In a nutshell, the 49er is a very tiny transceiver built for operation on 40 meters. Depending on the supply voltage, you can expect to see about 250 mW with a 9 volt battery, and about 500 mW at 12 volts.

Frequency control is by VXO. The fundamental crystal frequency is 7.040. Depending on how you assemble your unit, you can expect to see around 7.037 to 7.042 MHz. Your mileage will vary.

The 49er also sports full QSK operation and very low current demand on receive. Best of all, there's not a single toroid to wind!

Space restrictions do not allow me to reproduce the entire circuit description or the artwork for the PC board.

Condensed circuit description

The 49er is based around a NE602 mixer. This mixer is the entire direct conversion receiver. By using a panel-mounted capacitor with a series inductor, the crystal can be pulled up and down in frequency about 5 kHz. The NE602 is the oscillator.

To help keep down AM detection, Wayne uses a tuned circuit ahead of the NE602. A brute force RF gain control is available so you can ride herd on the incoming signal. This gain control is also used as the volume control. There is no separate volume control used in the 49er.

On the transmit side, there are only two stages, a buffer and a PA. Emitter keying is used on the buffer. The PA is biased for class C operation.

Odds and ends

I have not built a 49er. I know many, many people have. Even though this is a really simple project, at most the 49er will do half a watt. You should be a well-seasoned low power freak to tackle milliwatting on 40 meters.

The 49er does not have a sidetone. That will be up to you. The 2N3866, the final, gets very upset at the least amount of SWR on the feedline. A really good 50 ohm load will be required at all times, unless you have access to a barrel of 2N3866s to use up.

You can get a PC board for the 49er from: Jim Gates, 3241 Eastwood Rd., Sacramento CA 95821. The price is $5. Make checks out to Jim Gates, *not* to NorCal. Price includes shipping.

The DYI keyer

This is one of my favorites! The DYI keyer is a very simple digital CW keyer. It makes perfect dots and dashes. It is *not*, repeat *not*, an iambic keyer. The DYI keyer does not generate a sidetone either.

But, on the other hand, it's very, very easy to assemble. Using only two simple CMOS ICs and a handful of parts, just about anyone can put the keyer together. There's nothing different here from the basic design of the original version. However, I did add .1 inch headers for the input and output lines. Also on a .1 inch header is the speed control. This makes connecting the DYI keyer into your existing rig really easy. It also gives the finished project a commercial look. The DYI keyer is $15 postpaid. Get one by sending a check or money order to me at the above address.

From the repair bench

I have a 2 meter transceiver on all the time for packet. Even though the rig is running from the battery bank and its nominal 12.5 volts, the dial lamps burned out. Thinking "This is no biggie," I placed a call to the manufacturer for replacement lamps. Whoa! Replacement lamps for this rig are $4.65 each! To make matters even worse, there are *six* lamps.

Looking though the current Hosfelt catalog, I spied some lamps that should work. At a buck a shot, why not give them a try? As it turned out, they are a perfect fit. I'm telling you this because these lights may be just what you have been looking for. They will easily fit between the dial and subchassis of an HW-9. They would be great for lighting up the meter on your HW-8. With a bit of work, you could press some in between an LCD digital panel for backlighting. And you just can't beat the price! If you're interested, the part number is 25-290. Oh yes! Call Hosfelt at (800) 524-6464; ask for one of their catalogs.

Hot HW-9s

Right after the Dayton HamVention, I got calls about HW-9 rigs running with very hot finals. I've been down this road before, but it's worth one more trip.

If your HW-9 seems to be producing more than 4 watts of power, it's very likely generating more RF as well. Along with the fundamental frequency, there's all kinds of stuff squirting out of the transmitter. This problem seems to occur more often than not on 15 meters and 10 meters.

Perhaps the best giveaway is if one or both of the finals are running hot. So hot, in fact, that you'll leave a patch of skin on the heat sink if you touch it.

The fix is generally easy. Most of the time, one or more stages before the final are out of tune. Go back and retune the mixers and oscillators. Don't necessarily go after maximum power. Follow the directions to the letter. In eight out of 10 cases I've had on my repair bench, retuning the mixer/oscillator stages fixed the problem. You may have to replace one of the final transistors if you're unlucky.

New QRP transceiver from Ten-Tec

Yup! That's right. Ten-Tec will be selling a new 40 meter transceiver kit. Maybe by the time you read this. Right now, most of the details are still kinda gray. Specific features have not been announced, but look for full CW QSK, a Ten-Tec tradition!

If you would like to send Ten-Tec your ideas of the perfect QRP rig, or fixes to old problems with current QRP technology, send them to: Scott Robbins KY2P, c/o Ten-Tec, 1185 Dolly Parton Pkwy, Sevierville TN 37862.

The OHR-100 from Oak Hills Research

Another new rig from Oak Hills Research is underway which will replace the very popular Explorer II. The new rig, called the OHR-100, will be a single-band CW transceiver. You can pick any band you want, *except for 15 meters*. Dick has put a lot of work into this new transceiver and has made dozens of improvements. Look for a true sine wave sidetone oscillator. Also, for improved receiver performance, a double-tuned bandpass filter.

By the time this hits the newsstands, the OHR-100 should be shipping. The price is $159.95. The OHR-100 is available from: Oak Hills Research, 20879 Madison St., Big Rapids MI 49307.

Books and more books

There's an old saying that "You can't work 'em if you can't hear 'em." Most of us have no idea when to even begin listening. But there's help from Bob Brown NM7M. His book *The Little Pistol's Guide to HF Propagation* may be the ticket between static crashes and filled log books. You can pick up one of Bob's books from: World Radio Books, ETC, P.O. Box 189490, Sacramento CA 95818.

I'm getting down to the bottom of the stack of HW-8 handbooks. They are still only $11, and that includes first class postage. DX is $14 airmail. By the way, if you're in VE land, the price is the same as for US, $11. When these are gone, there will be no more printed. Get your copy from me at the address at the top of this column.

A 20-Foot Sky Hook

Build it for less than $10!

Joseph M. Plesich W8DYF
173 Brockton Road
Steubenville OH 43952

If you have a need for a neat little mast in the 20-foot category, here's one that is inexpensive and easy to construct. In fact, you can have this one up in less than an hour and have enough change from a ten-dollar bill to buy a cup of coffee.

"You can have this one up in less than an hour and have change from a ten-dollar bill to buy a cup of coffee."

This mast is not a new idea of mine, but I like it so much that I'd like to share it with you. I first read about it in Ed Noll's *Easy-Up Antennas*, published by Howard Sams, a book that should be in the library of every ham who likes to play with antennas.

To construct this mast, go to your local builders' supply store and buy two pieces of 10-foot schedule 40 PVC pipe—one 2 inches in diameter and one 1.5 inches in diameter. While I was buying the pipe, I picked up some 1/4-inch by 3-inch bolts with nuts and lock washers to connect the two pieces of pipe. I also bought two 3-inch eyebolts to put at the top of the mast.

When I got home, I laid the two pipes end-to-end on the patio. I slid the smaller pipe into the larger one about a foot. Next, I drilled two 1/4-inch holes about 9 inches apart and fastened the two pieces of pipe together with the 1/4-inch bolts, nuts, and lock washers. At the top of the mast I drilled two 1/4-inch holes in the smaller pipe and put the eyebolts in these holes. I cut two pieces of 3/32-inch black Dacron™ rope about 40 feet long and put them through the eyebolts. These ropes can be used to haul up an antenna, or be used as guys. The mast is now complete.

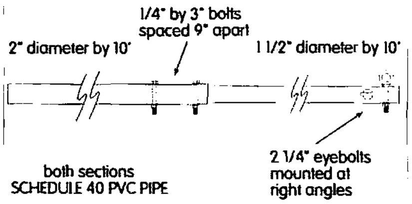

Fig. 1. Construction details for the 20-foot sky hook.

Next, I pounded a fence post into the ground and lifted the mast onto it. The mast is surprisingly light and easy to handle—except in a strong wind. However, I made the mistake of buying a lightweight fence post. When I slipped the mast over it and started to pull my antenna up with the rope, the fence post bent. I rummaged through the garage, found a piece of TV mast, drove it into the ground, and slipped the mast over it. The bending problem was cured. Next time, I'll spend the extra buck and get a heavy-duty steel post.

Now that you have found out how simple and inexpensive this mast is to construct, here are some suggestions on how you can use it:

- You can use it to hold up the center of an inverted-V antenna. Use the same type of mast, only with one section of pipe, to hold up the ends of the antenna.

- Construct a vertical for 10, 12, 15, or 20 meters by running a wire up the length of the mast. Feed it with coax at the bottom, and don't forget the radials.

- Plant three or four of these masts around your property and use them to hold up a triangle or loop antenna.

- Use it to support the ends of your sloper.

- It makes a great lightweight mast for Field Day and portable operation.

Currently, I'm using one to hold my 300 ohm feedline away from my house so it doesn't touch the roof or gutter. As you can see, there are many uses for this simple mast. I'm sure you will be able to think of others to fit your particular needs and location. Build one or two and see for yourself. 73

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Special for November

November is expected to be a very quiet month compared to October. You may expect some geophysical disturbances around the 1st and 2nd, and again around the 22nd and 23rd. The remainder of the month will see conditions between Fair and Good. The best days are likely to occur between the 6th and 15th, when the ionosphere is expected to be quiet. With luck, we may see elevated solar flux values (75-80 or so) during this period. Do not expect miracles, however, as we're still in the sunspot doldrums, and probably will remain there at least for another three or four months. I'm hoping to be able to forecast a vigorous Spring '97 HF propagation season.

NOVEMBER 1996

SUN	MON	TUE	WED	THU	FRI	SAT
					1 P	2 P
3 P-F	4 F	5 F-G	6 G	7 G	8 G	9 G
10 G	11 G	12 G	13 G	14 G	15 G	16 G-F
17 F	18 F-G	19 G-F	20 F	21 F-P	22 P	23 P
24 P-F	25 F	26 F-G	27 G	28 G-F	29 F	30 F-G

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA								15	15	15	15	15
AUSTRALIA						40	20	20			15	15
CANAL ZONE	20	40	40	40	40		20	15	15	15	15	20
ENGLAND	40	40	40				20	20	20	20		
HAWAII		20			40	40	20	20				15
INDIA							20	20				
JAPAN							20	20				
MEXICO		40	40	40	40		20	15	15	15	15	
PHILIPPINES							20	20				
PUERTO RICO		40	40	40	40		20	15	15	15	15	
SOUTH AFRICA									15	15	15	
U.S.S.R.							20	20				
WEST COAST			80	80	40	40	40	20	20	20		

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20						15				
ARGENTINA										15	15	15
AUSTRALIA	15	20				40	20	20				15
CANAL ZONE	20	20	40	40	40	40			15	15	15	20
ENGLAND		40	40					20	20	20	20	
HAWAII	15	20	20	20	40	40	40					15
INDIA								20	20			
JAPAN								20	20			
MEXICO	20	20	40	40	40	40			15	15	15	20
PHILIPPINES								20	20			
PUERTO RICO	20	20	40	40	40	40			15	15	15	20
SOUTH AFRICA										15	15	20
U.S.S.R								20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	20	20	20		40	40	40	40				15
ARGENTINA	15	20		40	40	40					15	15
AUSTRALIA		15	20	20			40	40				
CANAL ZONE			20	20	20	20	20	20				15
ENGLAND									20	20		
HAWAII	15	20	20	40	40	40	40					15
INDIA		20	20									
JAPAN	20	20	20			40	40	40			20	20
MEXICO			20	20	20	20	20					15
PHILIPPINES	15						40		20			
PUERTO RICO			20	20	20	20	20	20				15
SOUTH AFRICA										15	15	
U.S.S.R.									20			
EAST COAST		80	80	40	40	40	40	20	20	20		

10-12 meters

Generally Poor, except for occasional transequatorial propagation with F2 openings on the best days—most likely South and Central America.

15-17 meters

DX to Africa and Latin America on the Good days possible, with short-skip out to about 1,000 miles or so in the U.S.

20 meters

Your best band for DX openings around the world from dawn to dark, and openings to the Southern Hemisphere after dark in evening hours. You can expect excellent short-skip during the daytime to 2,500 miles or so.

30-40 meters

These bands ought to be open for DX from just before sunset to just after sunrise. Signals from the east should peak until midnight, and after midnight to other areas. Daylight short-skip of about 500 miles will be possible, and nighttime short-skip to 1,500 miles or more will be available.

80 meters

Occasional DX to various areas of the world should be possible between sunset and sunrise when QRN levels permit on Good (G) days (see calendar), and also short-skip during hours of darkness to 1,500 miles or more.

160 meters

Following the usual summertime slump, this band ought to begin to come alive again during the hours of darkness when QRN permits. Try the days marked (G) on the calendar for best results. DX toward the east until midnight, and to other areas afterwards until dawn. Short-skip to 1,500 miles will prevail when the band is quiet. W1XU.

NEVER SAY DIE

Continued from page 79

when I was about seven and my family had dinner at a friend's house where he played his classical records. It was love at first hearing for me. From then on I'd often ride my bike the 10 miles to his house just to listen to his records. The first record I ever bought (I still have it) was Strauss' Tales from the Vienna Woods and The Blue Danube.

Are you exposing your children and grandchildren to "good" music, or letting other kids suck them into rock as a way of life and probably resulting mediocrity?

Maybe I should reprint my recommended 100-CD classical library list that I published in *CD Review* for people who don't know what's "good." I'll add it to my list of things I should do when I have time.

Barter 'n' Buy

Turn your old ham and computer gear into cash now. Sure, you can wait for a hamfest to try and dump it, but you know you'll get a far more realistic price if you have it out where 100,000 active ham potential buyers can see it than the few hundred local hams who come by a flea market table. Check your attic, garage, cellar and closet shelves and get cash for your ham and computer gear before it's too old to sell. You know you're not going to use it again, so why leave it for your widow to throw out? That stuff isn't getting any younger!

The *73* Flea Market, Barter 'n' Buy, costs you peanuts (almost)–comes to 35 cents a word for individual (noncommercial) ads and $1.00 a word for commercial ads. Don't plan on telling a long story. Use abbreviations, cram it in. But be honest. There are plenty of hams who love to fix things, so if it doesn't work, say so.

Make your list, count the words, including your call, address and phone number. Include a check or your credit card number and expiration. If you're placing a commercial ad, include an additional phone number, separate from your ad. This is a monthly magazine, not a daily newspaper, so figure a couple months before the action starts; then be prepared. If you get too many calls, you priced it low. If you don't get many calls, too high.

So get busy. Blow the dust off, check everything out, make sure it still works right and maybe you can help make a ham newcomer or retired old-timer happy with that rig you're not using now. Or you might get busy on your computer and put together a list of small gear/parts to send to those interested?

Send your ads and payment to: *73 Magazine*, Barter 'n' Buy, 70 Rt. 202N, Peterborough NH 03458 and get set for the phone calls. The deadline for the January 1997 classified ad section is November 12, 1996.

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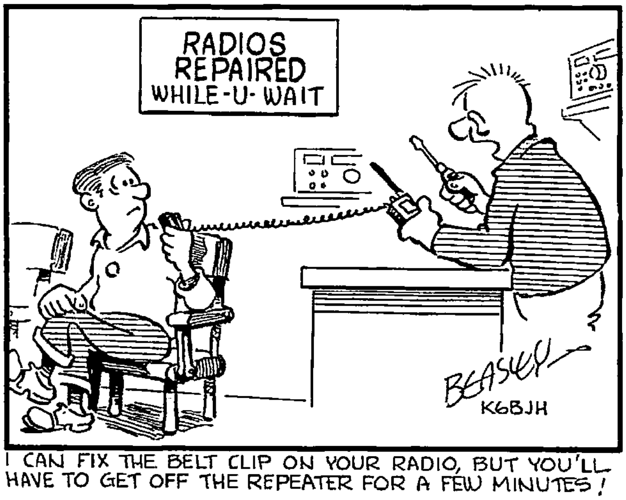

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DECEMBER 1996
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HAM RADIO FUN SECTION

On the cover: Santa stuffs stockings with goodies from Alinco. See "New Products." Photo by Jim Paliungas, Palimor Studios.

Feedback: Any circuit works better with feedback, so please take the time to report on how much you like, hate, or don't care one way or the other about the articles and columns in this issue. G = great!, O = okay, and U = ugh. The G's and O's will be continued. Enough U's and it's Silent Keysville. Hey, this is *your* communications medium, so don't just sit there scratching your...er...head. FYI: Feedback "number" is usually the page number on which the article or column starts.

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Contract: By reading this fine print you have hereby legally bound yourself to try one new facet of amateur radio in the next 30 days. Are you on packet? If not, pick up a TNC and check it out. How about RTTY or AMTOR? You'll meet some pretty friendly hams on these modes. Even the DX will rag-chew.

Number 1 on your Feedback card

NEVER SAY DIE

Wayne Green W2NSD/1

Bah, Humbug!

If you are the kind of person who tends to look on problems as challenges, our country and the world are sure full of challenges. We have some great challenges in Rwanda, Bosnia, Chechnya, Sri Lanka, India, Somalia, Haiti, Afghanistan, and so on. Here at home there's the challenge of straightening up the mess we've allowed our Congress to make of our school system, health care, drugs, poverty, and so on.

Outside of those global and national challenges, which call for you to cooperate with others interested in change in order to make a difference, which is probably asking too much, how about your personal challenges? How much thought have you given to making your own life happier and healthier? And that of your family?

How about a Christmas present of a few days in the Caribbean this winter? Or a ski vacation to Aspen? Or perhaps an extended weekend in Paris, London, Berlin, or Rome? Check out those travel agency specials. Hey, it beats the heck out of some pairs of socks. And with a little extra effort, you can get a temporary operating permit and bring along an HT so you can meet some local hams. We really *do* have a fraternity, you know.

I can guarantee that the hams on every Caribbean island will welcome you with a smile and want to show you around. Ditto the Hawaiian Islands, if they're closer.

None of this has to cost a bundle, once you know the ropes. Sherry and I are thrifty travelers (we're cheap). Hey, it's fun being thrifty, even when you don't have to. But the bottom line is that without spending a lot of money we've been to Europe, Asia, Africa, South America and the Pacific. Now what better Christmas present for your wife than a few days visiting, say, Guadeloupe? It's French, and the hams are beyond belief in friendliness.

Cost too much? Only if you believe that. Travel just doesn't have to cost a lot when you know the ropes. But my next suggestion is to give some books for Christmas. They can not only be fun to read, but help change lives. No, I'm not talking about the latest best-selling novels. Check back through my editorials for books I've reviewed or invest a big $5 in my 24-page list of recommended books (available from Radio Bookshop), and pick a few that are both fun and mind-expanding to give.

Or combine the two gifts so you and your wife will have some great books to take along to read on your next trip. I always bring at least a half dozen books on my trips. There is no better inexpensive gift than a well-chosen book.

Hey, if you run into any particularly good travel bargains, please drop me a note in case I might be able to get away for a few days too. There's still a bunch of great places my wife and I haven't visited yet.

The ARRL Election

Just as it has for the almost 60 years I've been a member, my ARRL biennial director election ballot arrived in the mail. I found myself with the choice of re-electing the current director, who I don't think I've ever met, or even worked on the air, but who looks like a nice enough old chap. Or the challenger, who was not wearing a jacket, his shirt collar was unbuttoned and tie pulled loose, which looked like good signs. But, sigh, it turned out he's been a member of the ARRL board for over 10 years. Sigh.

Hobson's choice, one insider or another. No fresh blood. No real choice.

And, oh yes, in their 300 allotted words they say they want to protect amateur radio's traditional values. I think that's the current shorthand for maintaining the code requirement so as to keep the hordes of no-coders ("they're not *really* hams") out of *our* already too crowded low bands.

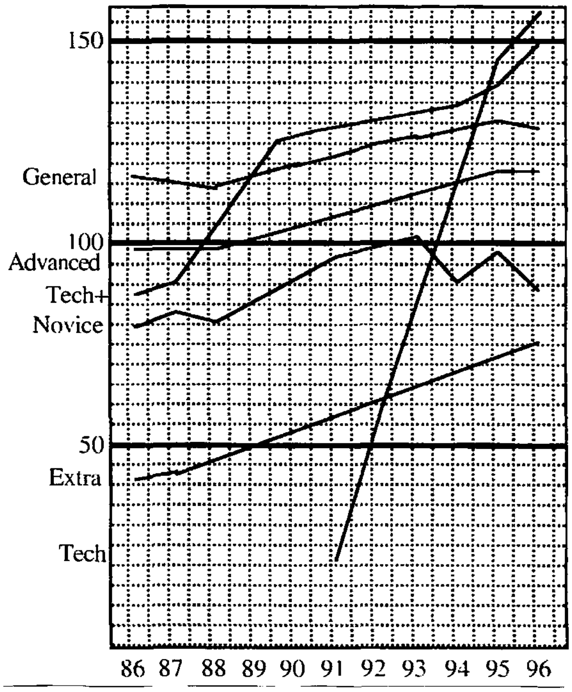
I haven't been keeping in close touch with the directors like I used to. Well, I used to provide a shoulder they could cry on about the stuff going on at HQ, and I was discreet about it. When Budlong was running the League with an iron hand he seldom had a problem with any directors getting elected that he couldn't control. He used to brag about how he could fix the elections. But I'm sure nothing like that is happening today.

My vote will go for the challenger. And two years from now, if I last that long, I'll vote for the new challenger. Never Re-elect Anyone. As a director, for Congress, or for President. Let's flush our political toilets as often as we can.

Ham Growth

The FCC figures for the last year are almost interesting. Growth? Well, we *did* gain 120 Advanced licensees during the last year. Of course that doesn't count the number of Advanced who got fed up with the hobby, got involved with other more important things (like golf), or dropped dead. Ooops, had their keys silenced. Well, gee, how about the General Class? With all those swarms of Techs coming in, our General Class must be bulging as they upgrade, right? Well, not quite. The number of Generals dropped by 1,841, not including those who, etc. Oh yes, the number of Novices dropped by 7,635. But then the number of Novices reached its peak in 1993. Yes, Techs and Tech+ are up, each by about 10,000 over last year. But Techs had been growing by about 30,000 a year for the four previous years, so this represents a surprising drop. About a 72% drop in one year! Yoiks. Is that a plummet?

Continued on page 13



Number 6 on your Feedback card

LETTERS

From the Ham Shack

Tony Mortimer KA8ICF. So the powerful ARRL has thrown a monkey wrench into Wayne Green's speaking at the Dayton HamVention. Gosh, such power the League has over the HamVention folks. Hmmm, I spoke to Dave Forbes KD8FO at the HamVention. He is the chairman of the Forums and Speakers committee. I told him I was disappointed and somewhat ticked off that the HamVention refused to include Wayne Green among their speakers. Dave told me that this was *your* choice and not theirs. He also said that you demanded a $1,000 speaking fee, plus all of your expenses (first class air travel, hotel, food) to be paid. Since the HamVention doesn't pay speakers, they declined. I think it is high time you level with your readers. You didn't exactly lie; you just didn't tell the whole truth and nothin' but the truth. And big bucks Wayne—"easy money"—whining that he can't make any money being an exhibitor at Dayton, so he pulls out. What about the 300 plus other exhibitors Wayne? They smarter and better business people than you. Well Wayne?

Fascinating! Never, since I gave my first talk in 1955 at Dayton, have I ever demanded a speaking fee or travel expenses. Most conferences, such as the Tesla Society and Global Sciences Congress, recognizing that well-known speakers tend to attract more attendees, do pay the travel and hotel costs for speakers. And since the HamVention forum chairmen in the past have told me that I pulled the biggest crowd of any speaker, I was surprised in 1995 when I was not asked to speak. I was less surprised when the rumor mill claimed that there was some bragging about a League official having a hand in this. So, back in February, having again not been asked to speak, I sent a letter explaining that I had a particularly important message this year. No answer. Below is a copy of my February letter to Ken Allen KB8KE, who was the listed forum chairman. By the way, "Big Bucks Wayne" is well known as "Never Spend a Dollar." I'm not cheap, I'm just thrifty, as anyone who's read my travel books will attest. So when I find that I'm losing money exhibiting at Dayton and can use the same money to send out a mailing and pull in two to three times as many subscriptions, guess where my money goes? I've found that Dayton is not a cost-effective way to sell magazines. Maybe you remember the big booth Ham Radio used to have? Look where it got them. Pffft ... Wayne

"From W2NSD/1 to: Ken Allen KB8KE, Forum Chairman. While I was disappointed to again not be invited to be on the program, I can understand the pressures you must be under from the League ... I'm their worst nightmare and you certainly can't afford to offend them. I've heard from several sources how they're gloating over being able to keep me off the program. My message this year is the most important I've had since I first spoke at Dayton in 1955. I'm calling for every ham club in the country to do their utmost to get at least one local ham elected to their state legislature. The next step is for this person to get on the educational committee and introduce a bill getting the state's schools to initiate an eight-year course in the fundamentals of electronics, communications, and computers for grades 5-12. Our country desperately needs high-tech career citizens to design, manufacture, sell, operate, and service the high-tech products which will dominate both business and home in the 21st century. This can help us get radio clubs started in every school in the country and revive the high growth we had from 1946 to 1964 (11% per year, steadily for 18 years!). Without something dramatic like this, how many years can we really hope to keep our hobby going, considering the mounting commercial pressures for spectrum and the billions they are willing to pay for it? Ham legislators have an added benefit to us of being able to provide some clout when matters of interference and antenna restrictions come up. We need to infiltrate the state legislatures, so I'm really disappointed that I won't be able to get this message across at the HamVention this year ... Wayne."

Jason Spitzer KD6HYB. There are a few (three or four, I suppose) of us out here who would like to use our Macs for ham radio related things. For example, I'm really interested in getting into the digital modes like packet, but it seems the entire hobby—more so than the computer field as a whole—is dominated by DOS/Windoze software and equipment. I really don't want to have to buy another computer (even a used junker) just to get into this area. I've used both platforms extensively, and, frankly, I like my Macintosh. Anyway, can you at some point run an article catering to the Mac ham minority out here? Possibly cover sources of hardware/software, etc.? I might also add that, due to their ease of use, the Mac is really an ideal computer for newcomers to the ham radio/computer topic. It really seems like there should be more demand.

Finally, in case you haven't noticed, the world below 30 MHz has become pretty much unusable for most of us city dwellers without the $$ to go out and buy a lot of expensive DSP equipment. The static caused by cheap lamps, dimmer switches, computer hash, and the like have made an incredible spectral mess. Heck, I can't even tolerate listening to the local WJJD 1160 AM 50 kW blowtorch at night, due to the anthropogenic noise! And shortwave broadcast listening is out of the question. It's really out of hand, Wayne; I've had a Tech-plus license for over three years now, and I've studied all the way through to advanced. But why should I bother to upgrade when I can't copy anything through the noise? Even when I eliminate all RF noise sources from my house, the neighbors are still using their

junk. I don't know what to do about the problem. Certainly, manufacturers could spend a few extra cents and design some noise limiting features into their electronic products. But, no doubt, these folks had their lobbyists in Washington when the FCC and legislators were establishing standards.

Your best bet is to live on a farm in New Hampshire where there are no neighbors and then throw out all your touch-lamps. That's what I've done ... Wayne.

Kent Hufford KQ4KK. In your August editorial in the section "Is CW Dead?" you state that knowing the code helped Scott O'Grady get out of Serb-held Bosnia. That's incorrect. Scott O'Grady did not send any Morse code (CW) any time during his ordeal in Bosnia. Scott never memorized the Morse alphabet. He did send a beacon and voice mode while there.

How do I know? In June 1995 I was assigned as the Chief of Staff Army's representative to the Chairman of the Joint Staff investigations of the shootdown and the successful recovery of Basher 52 (Capt. O'Grady). I spent a week in the AOR, was on the Teddy Roosevelt, the USS Kearsarge, in Naples, Stuttgart, etc., on the investigation team. We studied the intelligence data and interviews with four-star rank on down. On our return to the US we interviewed Scott at Andrews Air Force Base. I had heard the story of his sending CW, but when I asked him about it, he replied, "What's CW?" I explained it was Morse code. He said he had not sent any Morse code and that while the older survival radios had a code sheet, the new ones did not. Scott was a very lucky guy, but the code did not help him. CW is OK, it just shouldn't be mandatory. Nor supported by a myth.

Thanks, Kent, for putting our CW-mongers straight on this. Though my ability to copy code saved my life and my submarine during WWII, I agree with you that the code should be learned and used for fun and no longer be mandatory ... Wayne.

George Lydecker KD6NEW. At last, an intelligent article about repeater coordination. Glen Zook's article expressed the frustration that many of us feel with repeater coordination as it now exists.

I'm one of those hams who live in Los Angeles under the disparity between open and closed repeaters on the 70 cm band. A quick check of any repeater guide for the 440 band shows that well over 90% of the repeaters listed are private or closed. SCRRBA, the Southern California Repeater and Remote Base Association, felt the need to coordinate yet one more private "members only" repeater to a store owner using it to help sell ham gear. This guy is also a member of the SCRRBA Coordinating Committee. SCRRBA allocated the same frequency pair to this store owner as was being used by one of the last open 70 cm community repeaters. This repeater has been coordinated and in use for all since 1993, and has provided public service for both the ham community and the public. Listen to the Metropolitan Amateur Repeater System Monday night net and you will hear friends and families using ham radio in the way it was intended. Each net begins with an open invitation to all licensed hams. This net gave me my first exposure to talking to other hams. I was made to feel welcome and I was treated as a peer. The new repeater owner, claiming eminent domain granted by SCRRBA, began a campaign to chase the open repeater users off. The situation got so bad that this guy was jamming the channel during nets.

We have hams who are as young as eight years old who would be virtually excluded from the use of 440 by the fees charged by these "business" repeaters. I listened as one young eight-year-old made her first check-in to a net, only to be jammed. And all this is under the endorsement of the SCRRBA.

Surely you exaggerate! Not even money and politics could make such a terrible situation here in America ... Wayne.

QRX . . .

Today's Young Hams Are Our Future

On the left is Alex Zagajewski N2UAO. Alex is a charter member of the Taconic Hills High School Amateur Radio Club (THHSARC) KB2YLU, and graduated fourth in his class. He was an honors student throughout high school, played varsity soccer and was the first student to successfully complete the Foundations of Research Class at THHS. Alex's project was a study of the effects of RF radiation at 146 MHz on cultured nerve cells. Alex is a member of the Rip Van Winkle Amateur Radio Society (RVWARS), has served as Field Day chairman for two years, often served as net control for the weekly ARES Net and has participated in many public service events. Alex is currently a freshman at PACE University In New York majoring in Computer Science and Mathematics.

On the right is Kyrilian Dyer N2TZT. Kyrilian is also a charter member of the THHSARC and was the Valedictorian of the THHS class of 1996. He also played varsity soccer. He is a member of RVWARS and has participated in Field Day and other public service events. Kyrilian holds a private pilot's license and can be heard aeronautical mobile over Columbia County and surrounding areas. Kyrilian is currently a freshman at MIT in Massachusetts, majoring in Aeronautical Engineering. Both Alex and Kyrilian have been Elmering other students at THHS and at a private school near THHS.

Thanks, Wayne Gearing N2ROR, for the above.

Phase 3-D Slated for Launch in April 1997 on Ariane 502

Paris, France (AMSAT News Service) — In a published report released Thursday, September 26, by the European Space Agency (ESA), Mr. Jean-Marie Luton, Director General of ESA, and Mr. Alain Bensoussan, Chairman of CNES (the French Space Agency) announced that the launch of Ariane 502 has now been tentatively set for mid-April 1997. It was also confirmed that the Phase 3-D International Amateur Radio Satellite will be on this flight. The other payloads are to be a pair of technological measurement packages for validation of the launch vehicle's ability to place two satellites into a geostationary transfer orbit (GTO).

These announcements came during a joint ESA-CNES press conference at ESA Headquarters in Paris called to outline the respective plans of the two agencies to correct identified deficiencies in the Ariane 5 launch vehicle. The actions are in direct response to a comprehensive report submitted in July by the Ariane 501 Inquiry Board that was chartered to investigate the loss on launch of the first Ariane 5 booster in early June.

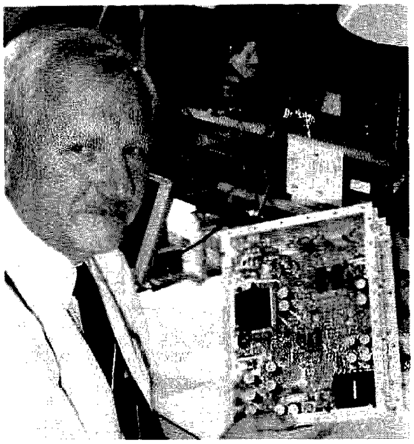
During the press conference, it was also reported that ESA's Atmospheric Reentry Demonstrator (ARD), a technology demonstration capsule for a future European manned space transport vehicle, along with an as yet unspecified commercial payload, is to be flown on a subsequent Ariane 5 vehicle, Ariane 503, which has been made a part of the Ariane-5 qualification process. This flight could take place in September 1997. The ARD had earlier been slated to fly on Ariane 502 along with the AMSAT Phase 3-D satellite.

In their announcement, Mr. Luton and Mr. Bensoussan outlined several specific actions that are now being taken by ESA and CNES to assure the correction of software contained in the Ariane 5 inertial reference system. Errors in this software were previously reported by ESA as being one of the primary causes of the Ariane 501 failure. Corrective actions include making changes to the Ariane 5 Functional Simulation Facility to make the qualification tests more representative of the flight environment as well as performing a comprehensive review of all the embedded software contained in the launch vehicle.

ESA and CNES also announced that the industrial architect on the Ariane project will henceforth assume the role of "software architect." This change will allow not only for verification of all software incorporated in equipment but also will help ensure the overall functional integrity of the launcher. Mr. Luton and Mr. Bensoussan went on to note that this means that all of the launch vehicle's software will now become subject to qualification reviews in which outside experts will take part.

In addition, the joint ESA and CNES announcement reported that working methods used in the Launcher Qualification Review have now been modified to introduce specialized audits on the most complex launcher systems in order to provide closer analysis wherever this is deemed necessary. A comprehensive review of the launcher's qualification is now also reported to be underway, along with systematic efforts to identify "degraded" modes of operation that could affect launcher elements.

AMSAT is a not-for-profit, 501(c)(3) educational and scientific organization that was first chartered in Washington, D.C., USA. Its objectives include promoting space research and communication by building, launching and controlling Amateur Radio spacecraft. Since its founding, over 25 years ago, many other like-minded organizations have been



Dr. Andras (Bandi) Gschwindt HA5WH proudly displays Phase 3-D's Battery Charge Regulator (BCR) at the Marburg P3-D Lab. The BCR is a critical piece of Phase-3-D flight hardware that will control all the spacecraft's onboard power activity such as regulating battery charging from the solar panels. The BCR was built by Bandi and his team at the Technical University of Budapest, Hungary.

formed around the world to pursue the same goals and who now also share the AMSAT name. Often acting together, these groups have used predominantly volunteer labor and donated resources to design, construct, and, with the added assistance of government and commercial space agencies, successfully launch, over two dozen Amateur Radio communications satellites into Earth orbit.

The Phase 3-D satellite, now under construction with the help of over a dozen AMSAT groups on five continents, will be the largest, most complex, and most expensive Amateur Radio satellite ever built.

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You Know It's Time to Get a New Hobby When...

You're saying grace over a meal with your family, and you finish, "N4TMI clear, er, Amen."

TNX Michael Covington N4TMI (from *ARNS*, March 1995).

Number 10 on your Feedback card

Automatic Packet Reporting System (APRS)

Holy packet, Batman! We can track anything with this!

Bob Bruninga WB4APR
115 Old Farm Ct.
Glen Burnie MD 21060

APRS is a radical change to packet radio, adding a map display, a new protocol, and a simple routing scheme to communicate the positions of stations, objects, vehicles, and other graphical information in real time over standard AX.25 packet. It was designed to improve the value of ham radio in emergency situations or public service events by taking advantage of this visual tactical display. In the past, packet radio has mostly been used for passing volumes of message traffic from point to point, but has seen little use for real-time events where information has a very short lifetime. APRS reverses this trend by rapidly communicating small packets of information to all stations simultaneously. The keys to the success of APRS are: map displays to see the locations of stations and objects; unconnected/broadcast packets to all stations at once; generic digipeater routing independent of callsigns; APRS versions for the Mac, Windows, and DOS.

Map displays

Maps at any scale, from the whole world for HF and satellite communications down to the inside of the Dayton HamVention Arena, are possible! In addition to geographical displays, APRS

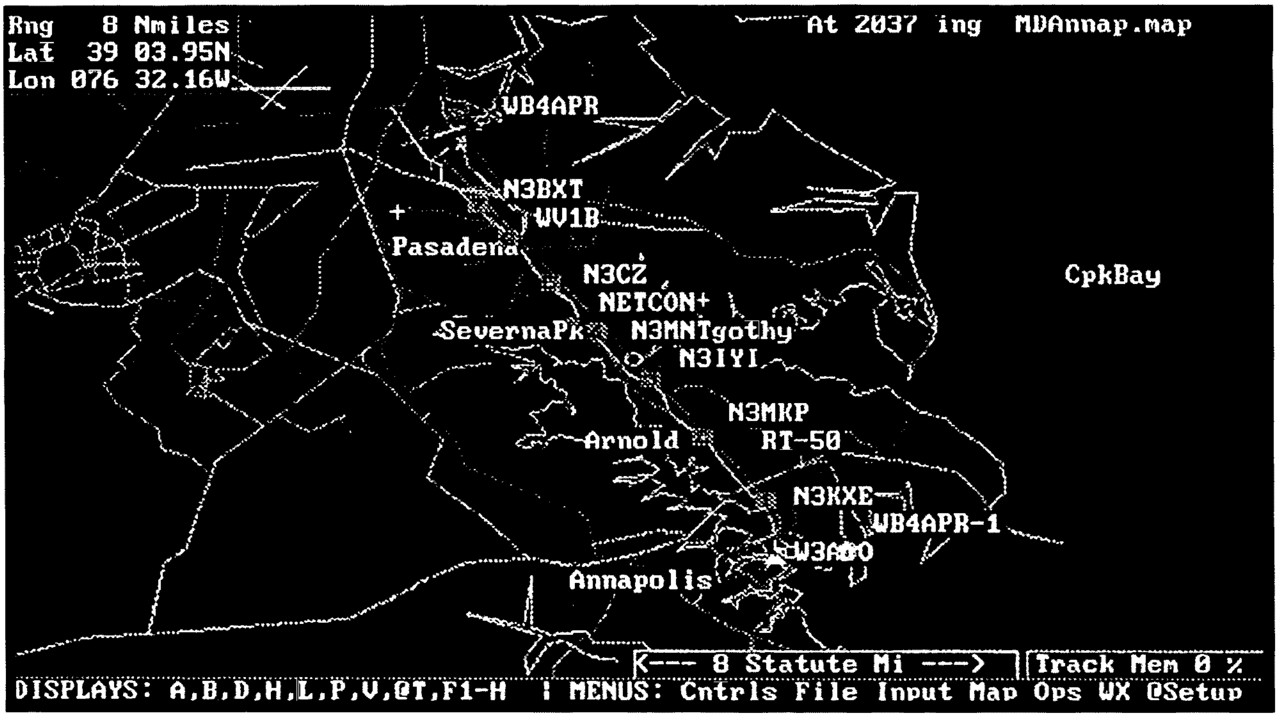


Photo A. *At this marathon in Annapolis, MD, the police officer at each checkpoint found the map display to be very valuable in predicting the arrival of the runners so that traffic could be stopped for street crossings.*

also handles and sorts operator messages, bulletins, and status packets onto separate display screens.

The utility of the APRS map displays should be obvious to anyone who has analyzed typical special event traffic. One of the greatest real-time needs at any special event or emergency is the tracking of key people. Where is the event leader? Where are the emergency vehicles? What's the weather at various points in the county? Where are the power lines down? Where is the head of the parade? Where are the VIPs? Where is the mobile ATV camera? Where is the hurricane? Where is the DX?

Unconnected broadcast packets

Another advantage of APRS over conventional packet is that it avoids the complexity and limitations of making connections to each station. APRS sends information as broadcast packets that permit any number of stations to exchange data, just like voice users would on a voice net. Any station with information to contribute simply sends it, and all stations receive and log it. To assure delivery to all stations, APRS packets are repeated periodically. After each transmission, the period to the next transmission is doubled so that older information is given lower priority than newer information.

Generic digipeater routing

An APRS operator needs no prior knowledge of the network to copy and send packets, because APRS takes advantage of the capability of any TNC at any station to serve as a relay for other stations. All APRS stations are initialized with the generic second callsign (alias) of RELAY so that any station can always get a packet out just by sending it via RELAY, or RELAY, RELAY. After monitoring an APRS channel for 10 minutes, every APRS station and digipeater will probably have appeared on his map. Using this visual geographic information, the user can then use more creative and specific routes for his intended area of interest. Similarly, all WIDE area APRS digipeaters are given the generic alias of WIDE and a second alias of RELAY. The typical path for a mobile is to use the path via RELAY, WIDE so that he is digipeated whether he is in range of a WIDE (RELAY) or any other APRS station. This usually suffices for typical radio nets.

"You can zoom in to any point on the globe!"

Applications

Although APRS was initially designed for tracking moving vehicles, it soon found applications in all facets of amateur radio. Any communications concerned with the location of anything can be tracked with APRS: SKYWARN; weather nets; hurricane tracking; both manual and automatic direction finding; plotting satellite contacts; monitoring DX packet clusters and plotting all DX spots automatically; marathon and other event tracking; plotting all stations on all frequencies for frequency coordinators; Meteor Scatter using the very short APRS packets; HF beacons (lets you see where the band is open); vehicle tracking; balloon tracking; Civil Air Patrol search and rescue; Coast Guard Auxiliary search and rescue; and frequency coordination are only a few possibilities.

Besides the map displays, there are many other display pages that collect information from packets on the channel. These displays give instant access to all the data in the network as follows:

•Latest Status: This display maintains a list of the latest status packet from each station. In effect, this is a multi-station online broadcast message

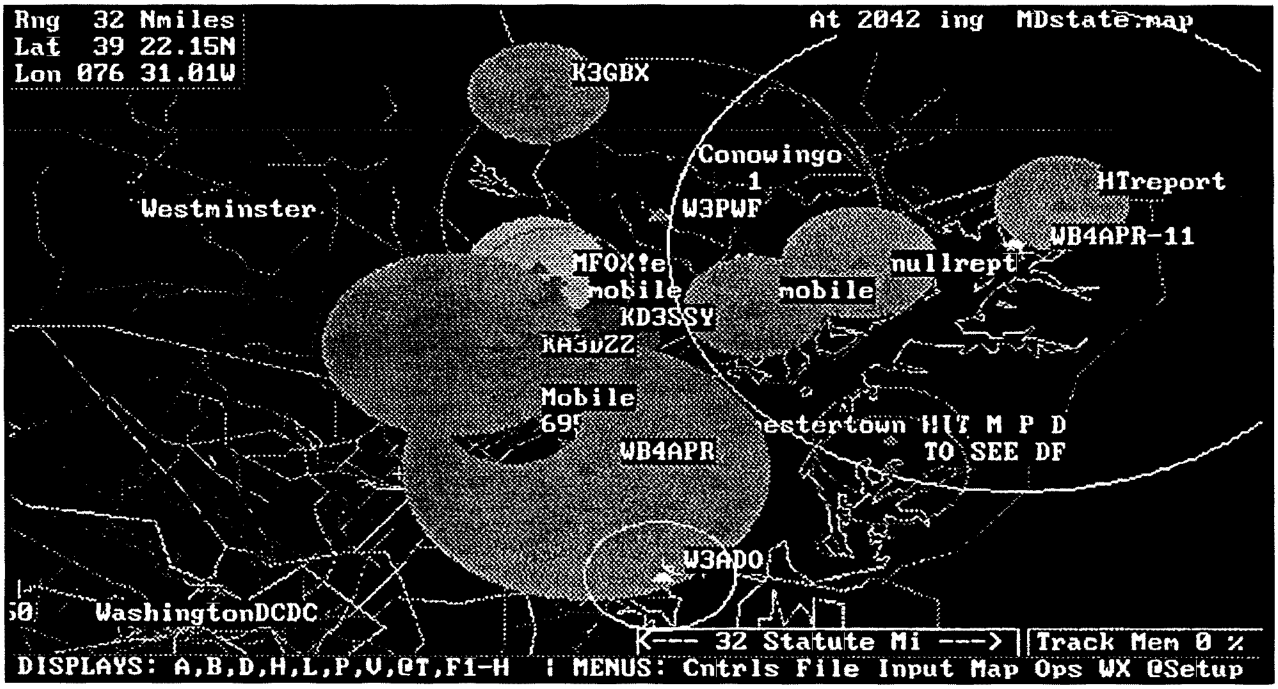


Photo B. APRS permits Direction Finding using only signal strength. Even null reports are very valuable in showing all the locations where the fox is not. *Brighter colored circles show increasing signal strength and gray circles show the null reports. The fox will be near the intersection of the brightest colored circles.*

NEVER SAY DIE

Continued from page 4

Now, pundits, how do you explain all that, and what do you see (if any) as ramifications?

And there you have it. Advanced grew at an average of 1.9% per year, which does look like growth until you figure out that around 3% are dying per year, mostly due to poor nutrition (Americans have one of the worst diets in the world) or smoking. Generals grew at less than 1% per year. Novices at 1.3%. Ho hum.

Congress Messing Up Again

Big surprise, right? Naturally, instead of tackling the source of the TVI (etc.) problem, which is the wide-open design of TV sets' front ends and the lack of RF bypassing on telephones and hi-fi systems by the manufacturers, Coingress (not a typo) is trying to put through a new law which would enable the states to close down interfering transmitters. Well, Congress (is con-gress the opposite of pro-gress?) has steadily cut the FCC's funds so they are impotent to cope with the problem, and the FCC, fought vigorously by lobbyists, has never been able to get the manufacturers to improve their equipment, so the Commission has had to pretty much just ignore the cries of distressed consumers.

Yes, some of the trouble stems from overpowered CB equipment. Being illegal, their high power amplifiers don't have to meet any regulations, so they're terribly dirty. But the design of TVs and other consumer electronics equipment is such that even a legal CB transmitter is likely to raise hob with the neighbors.

And with the proliferation of transmitters as two-way communications expands exponentially, and with no hams on our state legislatures to help protect us from really stupid state laws being passed, if this doozie (S.2025) goes through we could get put off the air by our local authorities, who won't know a ham rig from a CB. If whatever you're doing interferes with that $199 TV next door, then shut it down. Or else.

Not content with having made our school system worse than most third-world nations (and by far the most expensive in the world); not content with having made our so-called health care system a ridiculously over-priced mess; not content with having spent more of your money on their "war on poverty" than it would have cost to buy all the Fortune 500 companies, plus every farm in America, with no detectable positive effect; not content with their totally lost drug war which has been primarily instrumental in the spread of cocaine and crack; now they've got us in their sights. Maybe we need another ham lobbyist in Washington with no budget to bribe our betters. Well, you can bet that the electronics equipment manufacturers lobbyists are there, and armed with whatever it takes. When money changes hands, no matter the rationalization, that Congressman is then acting as a paid agent.

Continued on page 19

Manuscripts wanted for May 1997 Construction/Gadget issue of *73*

Write about that ham radio gadget you built, and get your article published in the May 1997 Construction/Gadget issue of *73 Amateur Radio Today*! Submit it on disk with a print out, to Joyce Sawtelle, 73 Amateur Radio Today, 70 Route 202 North, Peterborough NH 03458, by the end of January.

system. In DX cluster mode, it accumulates a list of all users and their latest commands to the cluster.

•Positions: This display shows the text of the position reports. They are time-stamped and may include brief comments. These reports may also contain DF or WX information. In DX mode, this list contains the positions of all DX spots and user locations heard.

•Maps: Maps from 100 yards up to 8,000 miles can be displayed, showing the positions of all stations. Stations reporting a course and speed are dead-reckoned to their present estimated position. Databases of most National Weather Service stations and the Civil Air Patrol search and rescue grid are built in. You can zoom in to any point on the globe! Megabytes of maps are available for APRS and more are made every day. Using the US Geological Survey $32 CD-ROMs, you can make a street level APRS map in about an hour.

•Messages: This display shows the last page of operator messages to and from your station. Incoming messages are immediately brought to the operator's attention.

•Bulletins: This screen displays all bulletins captured. They allow one station to send multiple lines to all stations.

•Traffic: This screen shows the last page of messages exchanged between other stations on the net. It is useful for "reading the mail." DX packet cluster talk traffic also shows up here.

•Heard log: This display maintains a count of the total number of transmissions from each station per hour. These statistics are ideal for displaying the connectivity of the network over varying paths, such as HF, or to see when stations enter and leave the net. On HF, this display can show propagation conditions to all areas at all times.

•Digipeater list: This display shows the raw packet header so that APRS users can see what digipeater paths are being used by other stations. The proper use of digipeaters is important in an APRS network. An asterisk in the first column means that you hear the other station direct without a digipeater! Change your UNPROTO path to NONE to chat with those stations. In DX mode, this list accumulates a list of all DX packet cluster messages heard.

•Telemetry page: This page displays the last 16 telemetry packets received. The APRS telemetry format allows for five analog channels and eight digital status bits. A complete APRS telemetry transmitter the size of a matchbox (with 1-watt xmtr!) is available for under $200.

APRS mobile vehicle location system for voice nets

APRS is almost universal, so many applications are moving off the purely digital channels and into voice networks. Since a position or object report is only a single one-second burst, many nets permit the packets on their voice channels to inform all stations of their locations. The Navy MARS program has used APRS for years on their HF afloat net. Although the military ships never report their position, the periodic position reports from the shore stations are like an automatic HF chirp sounder. The ships just leave APRS monitoring the voice phone patch channel, and they can see

"GPS trackers have been installed in a football helmet, a model of the Olympic torch, and even on cows! With the advent of GPS, everything can be tracked!"

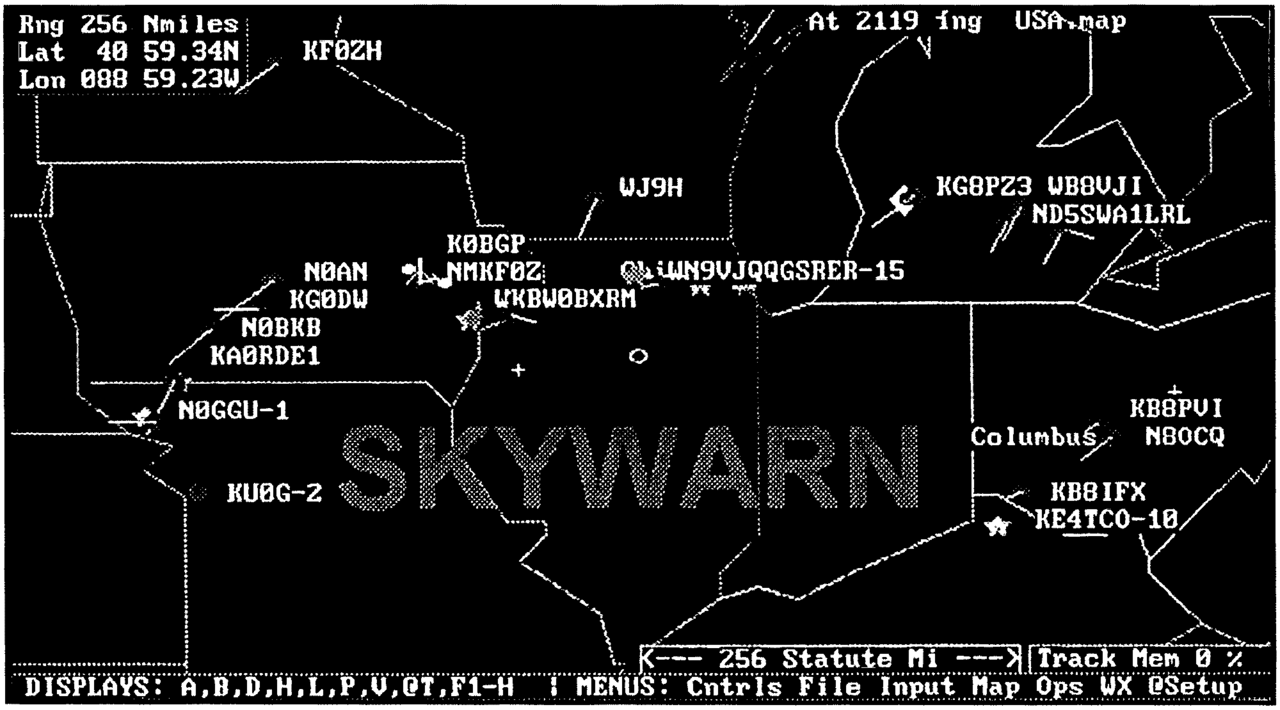


Photo C. Not only does APRS show the location of all SKYWARN weather spotters, it can also show dozens of special WX symbols and even dead-reckon the movement of the storms being tracked.

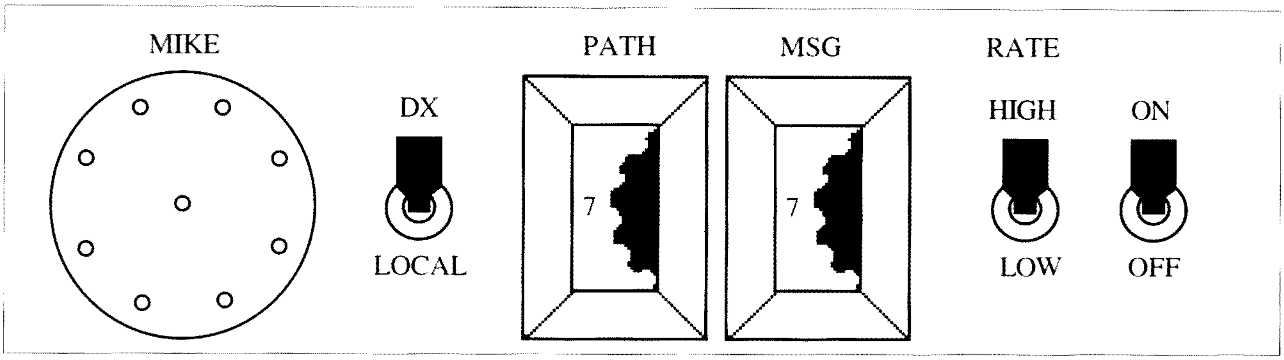


Fig. 1. The PATH thumbwheel switch gives 4 bits of routing information, and the second thumbwheel switch allows the operator to select one of seven predefined messages on the front panel of the APRS mike encoder. The rate switch allows the operator to select the high rate for frequent reporting and a four-times-lower rate for benign operations. The mike encoder is available from the Tucson Amateur Packet Radio (TAPR) Organization: @tapr.org.

on their maps at a glance what shore stations are monitoring and where the band is open, without having to make tedious voice call-ups. Not only do active stations show on the map, but the HEARD screen shows how many packets, per station, per hour, have been received.

APRS mike encoder

Recognizing the move towards automatic position reporting for all mobiles, the APRS mike encoder was designed to provide mobile position reporting without the requirement for a TNC, and additional radio and antenna. The APRS mike encoder appends a very short 0.3-second position tone burst on the end of your voice transmission, allowing automatic vehicle tracking in any vehicle with a two-way radio! The mike encoder is just a black box on your dashboard that plugs into the mike jack of any radio. A GPS and your mike plug into it, as shown in **Fig. 1**. It has a number of front panel switches to select any one of seven status messages, and to select various paths for your position report to take.

This mixing of voice and packet can be made totally transparent to the users on a properly configured repeater. Since the packet is only 0.3 seconds long, a TNC at the repeater site detects the packet on the repeater input and instantly mutes the repeater output so none of the voice users hear it. This 0.3 seconds is minimal compared to the typical one-second courtesy beep found on most modern repeaters. So where does the position report go? The TNC digipeats it not onto the repeater voice channel, but onto the local wide area digital APRS tracking channel. Since all position reports on all frequencies are digipeated onto this single APRS digital channel, stations monitoring the APRS frequency will be able to keep track of *all* mobiles on *all* frequencies!

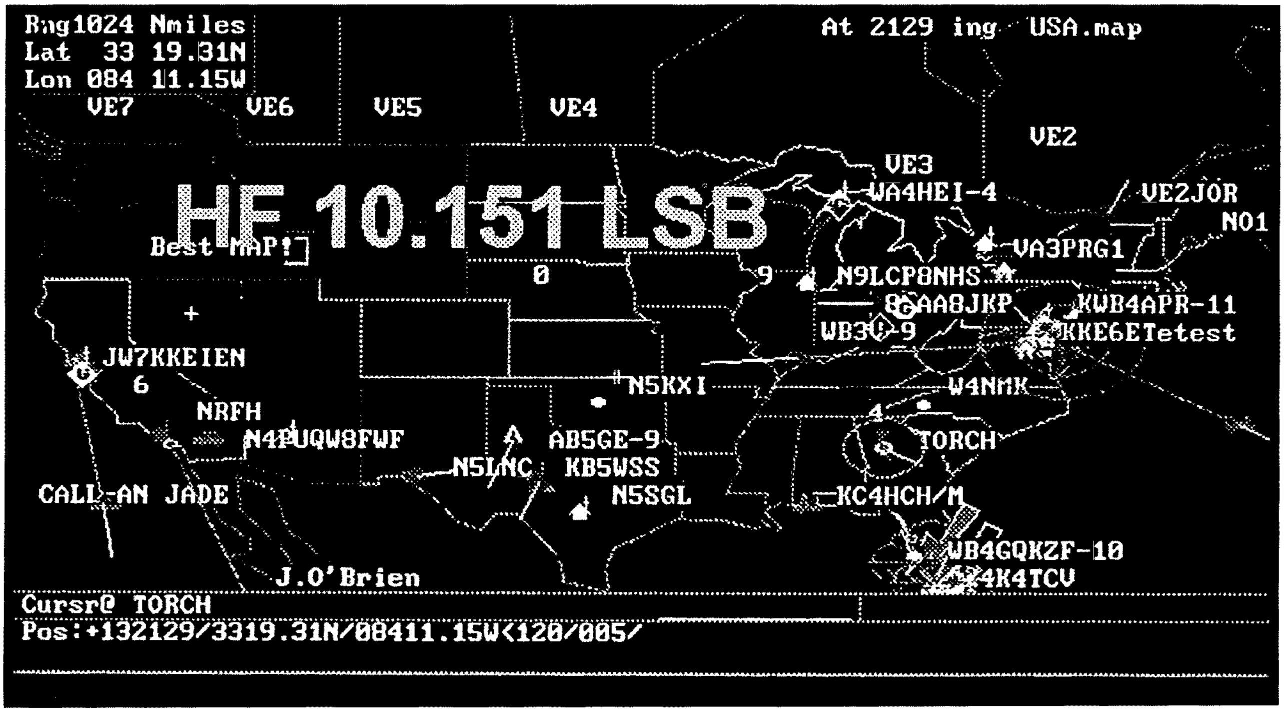


Photo D. This display shows the typical activity on the National APRS tracking frequency of 10.151 LSB. If you look closely you can see mobiles, including the Olympic Torch, among the numerous station and WX reports.

Routing path

```
x x x x }—The four routing bits.
| | | |
| | *-*——These two bits represents the number of hops if omni
| | or four directions if directional: NORTH = 11
| | EAST = 01
| | SOUTH = 10
| | WEST = 00
| |
| *——A 1 here indicates LONG DISTANCE vs LOCAL
|
*———A 1 here indicates an OMNI vs a DIRECTIONAL PATH
```

Fig. 2. *APRS mike encoder routing bits. A special APRS TNC at the repeater site decodes this information and sends the packet in the appropriate direction.*

Since the object of the APRS mike encoder is to encode the position into the shortest possible packet, the long list of digipeater callsigns are eliminated. In their place are only 4 bits which allow for local and longer distance reporting, omni or directional, and provision to control the direction of propagation (see **Fig. 2**). The TNC at the voice repeater is a special APRS TNC that recognizes these bits as routing information and regenerates the packet by re-inserting the appropriate digipeater callsigns as needed to represent the indicated path. To do this the TNC has five special directional UNPROTO paths pre-loaded with the appropriate north, south, east, west, and omni paths. If the omni bit is set, then the TNC will digipeat the position reports via the single callsign WIDE-N, where N is the lower 3 bits of the original SSID. This path will radiate outward in all directions with no duplicates since each properly configured WIDE digipeater will repeat it only once and decrement the -N by one. This specialized routing algorithm is called the WIDE-N algorithm and requires that the digipeater maintain a copy of the last minute's worth of packets so that it can compare and avoid duplicating a packet that it has already sent. Until the new special APRS Voice Repeater TNC is installed at all repeaters, the APRS mike encoder can operate with the full digipeater UNPROTO path in its transmitted

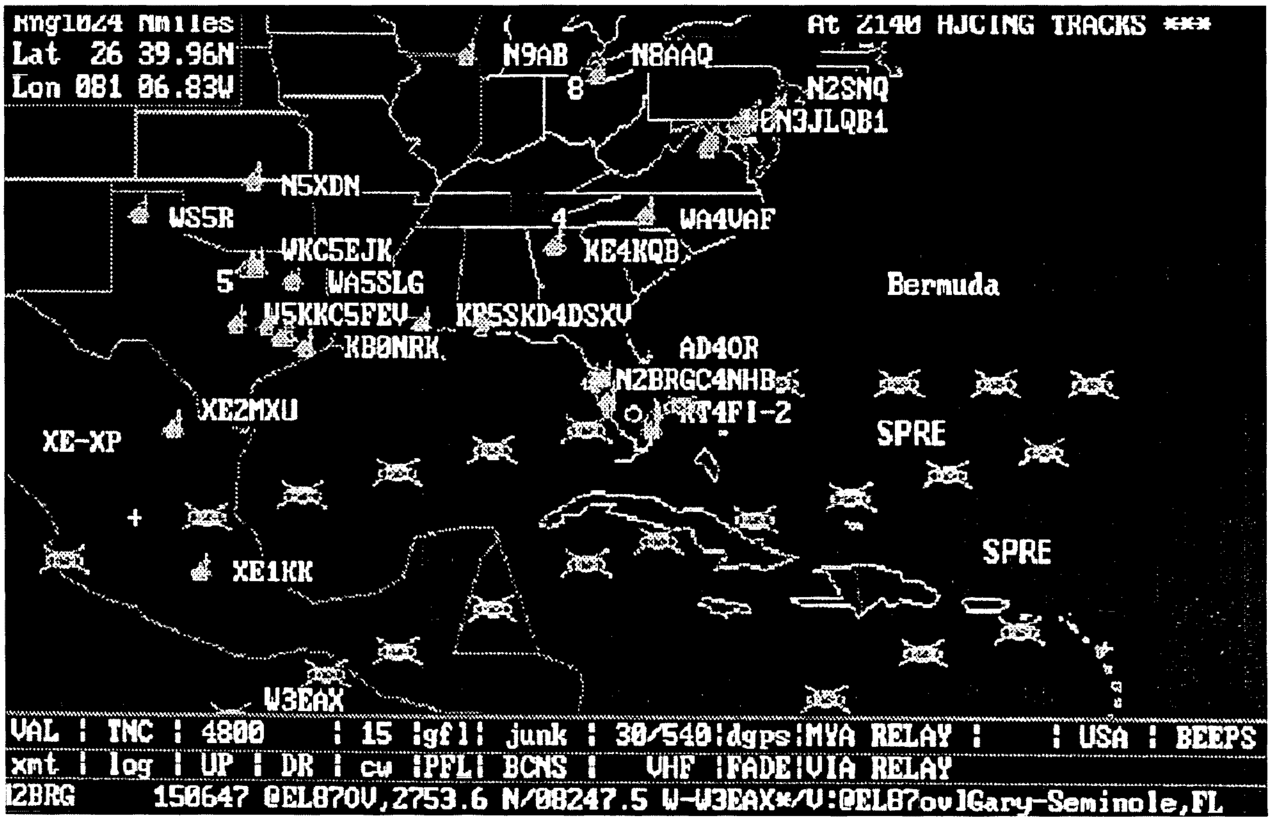


Photo E. *This APRS display was saved during the Space Shuttle SPRE mission in January 1996. In this experiment, the payload built by students at the University of Maryland beaconed its own GPS position.*

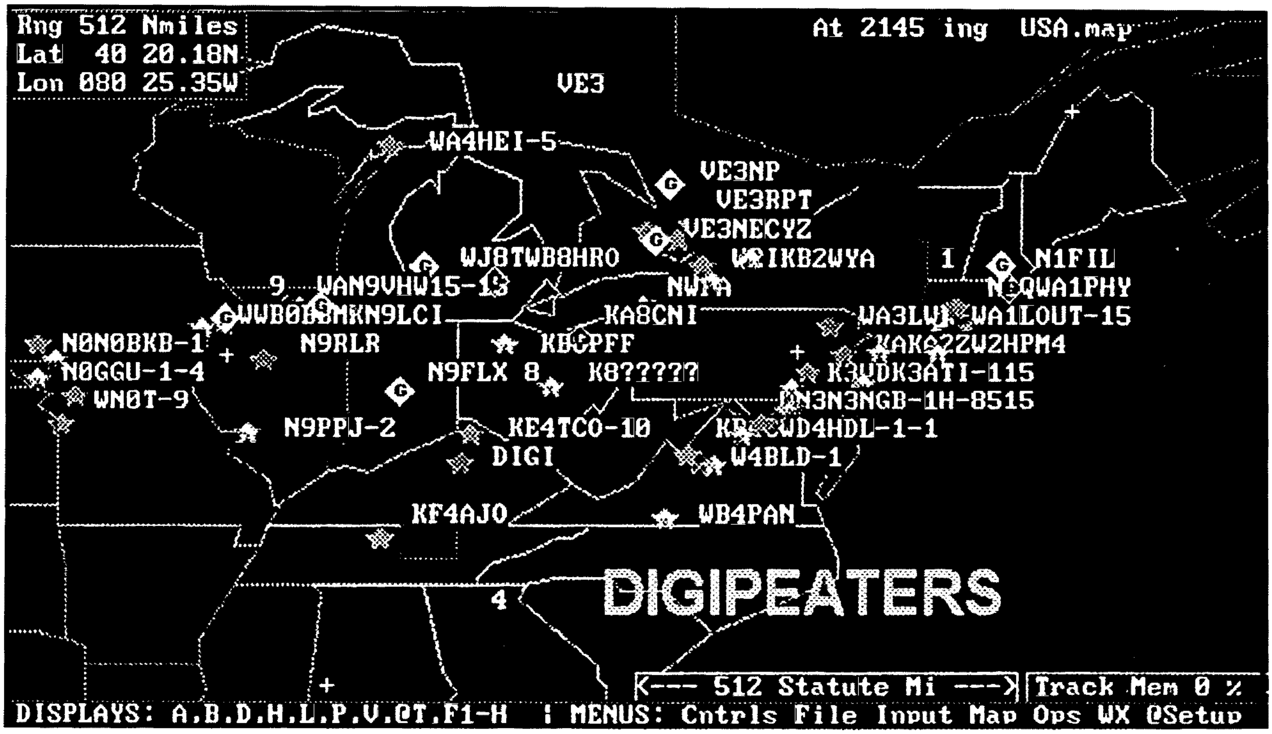


Photo F. *This display shows all of the APRS WIDE area digipeaters in the northeast. There are comparable numbers in the west and southeast.*

packets. The only shortcoming is that these packets are longer, up to 0.6 second long.

Station tracking

Although APRS automatically tracks mobile packet stations interfaced to GPS or LORAN navigation, it also tracks perfectly well with manual reports or grid squares. Additionally, any station can place an object on its map, including itself, and within seconds that object appears on all other station displays. In the example of a parade, as each checkpoint with packet comes on line, its position is instantly displayed to all in the net. Whenever a station moves, he just updates his position on his map and that movement is transmitted to all other stations. To track other event assets, only one packet operator needs to monitor voice traffic to hear where things are. As he maintains the positions and movements of all assets on his screen, all other screens running APRS software display the same maps. There is also a tracking command on the P display that will cause APRS to keep the map display always centered on a selected object.

Automatic event tracking

For predictable events such as marathons and other races (even the running of the Olympic Torch), there is a version of APRS called APRSdr that can automatically dead-reckon any number of objects along a given map course. Just place the symbols on the course, give them a speed, and APRSdr will move them along the course and transmit their new positions every N seconds to everyone on the net. For marathons, just give the leader a speed of 9 knots and Tail-end Charley a speed of 3 knots and you don't even need GPS! If the symbols get ahead or behind, simply select them with the cursor and move them to where they are. Using APRSdr in this manner frees up your limited number of GPS trackers for those assets that are not predictable, such as race officials and service vehicles.

"APRS users can set weather alarms and be alerted when conditions exceed given values."

Using APRS position reports on all packet stations

APRS can be used to monitor any packet frequency to collect information on other stations on that channel. As more and more networks include the position of all key assets in their ID packets, APRS can be used as a general purpose network topology display on any packet frequency! Even if the positions are manually entered onto an APRS map, such APRS backup files make an excellent mechanism for distributing frequency usage information in an easily maintained map format. Since APRS captures only beacons, it is a great tool for monitoring the activity of a busy packet channel. Just monitor for an evening, and APRS will identify all stations on frequency and capture their beacon text and/or ID packets. This is a great way to locate all packet stations on a frequency.

Space applications

The problem with space packet is the saturation on the uplink by hundreds of stations which makes the use

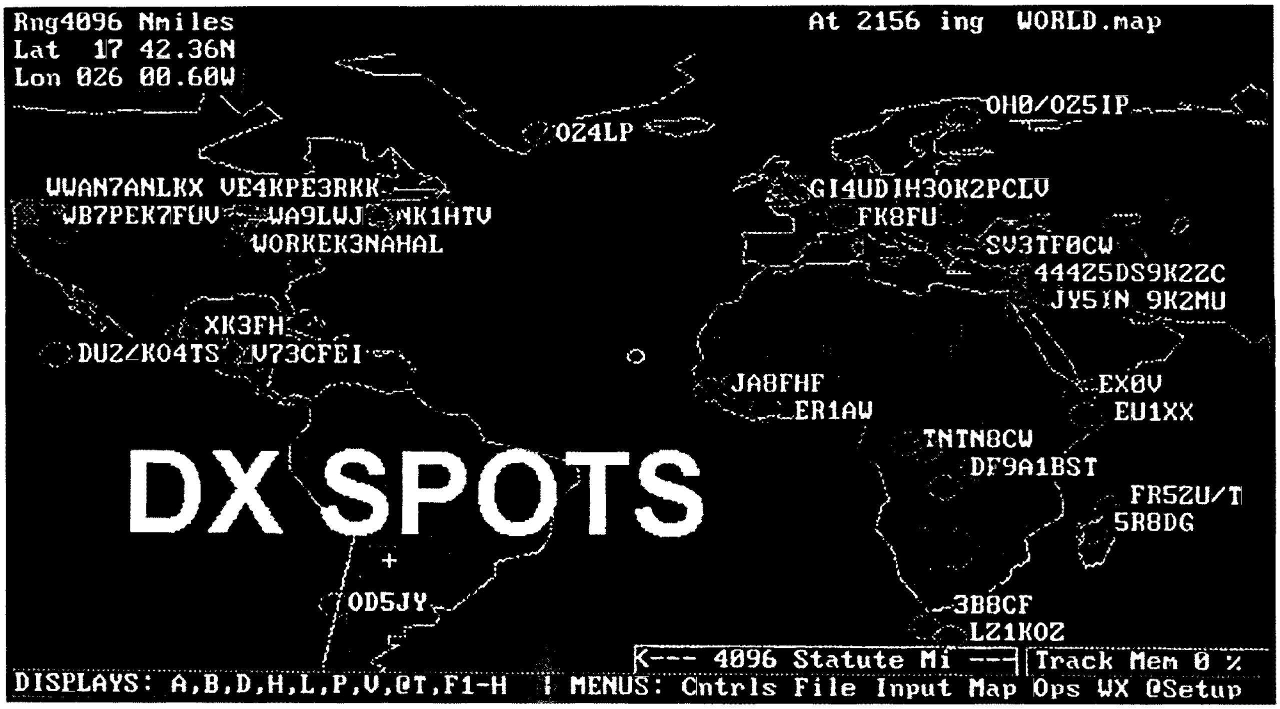


Photo G. APRS will plot the positions of all DX spots and grid squares that it monitors on the local DX cluster. It also gathers a list of all users and all messages posted on the cluster just by monitoring the frequency.

of a normal "connected" protocol impractical. The shortest possible "connected" contact requires a total of five successive and successful packets. APRS reduces this to one packet, and also capitalizes on the most fascinating aspect of the amateur radio hobby—the map display of the location of those stations.

A special version of APRS called "APRtrak" was donated to the AMSAT software library. It will compress your position report to only six letters using the Maidenhead grid square and transmit that in the TO address field of a very short packet. Similarly, it will plot any such stations heard. If everyone used APRtrak instead of trying to connect with orbiting packet digipeaters such as SAREX, then everyone within the satellite footprint would see the location of every successful uplink. In January 1995, during mission STS-72, students at the University of Maryland built a 2 meter digipeater called SPRE that flew for 18 hours from the Space Shuttle. During those brief 18 hours (with only three low passes over the southeastern USA between midnight and 3:00 AM) more than 70 stations were plotted.

Currently APRS position reporting via satellite experiments are being conducted on the amateur WEBERSAT WO-18 which has a 2 meter uplink and 437 MHz downlink. Although the downlink requires special PSK modems, the uplink can use a standard FM radio and modified TNC.

Fox hunting or direction finding

APRS will plot the location of a hidden transmitter, balloon, or interfering signal, and display the intersection of bearing lines from a number of reporting stations, and overlapping signal strength contours, if only signal strengths are reported. Finally, APRS includes the Fade-Circle Search and Rescue technique which can be used by a mobile with only an omni antenna to locate a hidden transmitter.

To use APRS for DFing, each station having a bearing report or a signal strength on the target simply enters that bearing, using the OPS-DF command. His station will then not only report his location, but also a line of bearing or signal strength contour. All stations running APRS will see any reported DF bearing lines and overlapping signal strength contours on their maps. Even with signal strengths alone (which anyone with *any* radio can report), the location of the signal can be

isolated down to a few miles or neighborhood. Further, APRS can track any DF vehicles using GPS or LORAN devices. There is an optional Doppler DF registration for direct connection to any of the Doppler DF units for automatically plotting and transmitting instantaneous DF bearings.

Weather station reporting

APRS position reports can include wind speed and direction, as well as other important weather conditions. APRS supports an optional serial interface to the ULTIMETER-II, Davis and WeatherMax home weather stations. With this interface, your station includes weather conditions in your position report for display at all other stations in the network. All weather stations show up as a bright blue circle, with a line indicating wind speed and direction. The NEXT command in APRS will successively highlight each

> ***"This is a benefit to everyone on the channel."***

weather station in turn, so that all reports can be collected at a glance. Optionally, the temperature, barometer, and wind speed can be shown next to each weather station instead of their callsigns. APRS also has a database of the locations of most National Weather Service (NOAA) sites for instant display, and can crunch a file of NOAA hourly WX conditions, and update all NOAA stations on the map. Finally, APRS users can set weather alarms and be alerted when conditions exceed given values.

DX packet clusters

The positional display and real-time user communications make APRS an ideal tool for the DX cluster user. Not only does he get to see all DX spots on the map at the instant they are transmitted to even the first cluster user, but by operating in the "monitor only" mode, he has reduced the overall packet load on the DX cluster. This is a benefit to everyone on the channel. Also, the APRS monitoring station will see the spot as soon as the first station gets it.

Frequency coordination

More and more BBSs, digipeaters, and nodes are including APRS position information in their routine beacons. If the frequency coordinating body makes available APRS backup files (or HST files) showing the positions of all coordinated services, both packet and voice, then these files can be distributed on BBSs and by other means to all hams in the area. By loading these files, users can instantly see the established frequency users in a geographical setting. Add the ability of APRS to plot crude range ring contours based on antenna height and gain to this visual reference, and you can see that APRS is useful for displaying the topology of any network, and the interference ranges of voice repeaters.

To date, APRS has been used at numerous marathons, walkathons, and special events. It has been installed on ships, boats, airplanes, and balloons. GPS trackers have been installed in a football helmet, a model of the Olympic torch, and even on cows! With the advent of GPS, everything can be tracked! This year, over 50 APRS mobiles showed up at Dayton and could be tracked all over the state.

APRSdos, MacAPRS and WinAPRS are available as shareware on most ham radio bulletin board systems. There is also an APRS special interest group on the Internet. Send a message to listproc@tapr.org and include the words "subscribe aprssig" in the body of the message. You may download these APRS programs via FTP from tapr.org in the tapr/SIG/aprssig/files directory.

Registration of these programs is $29 for APRS. $50 for Mac and $60 for WinAPRS.

APRSdos Registrations: Bob Bruninga WB4APR, 115 Old Farm CT, Glen Burnie MD 21060.

MacAPRS Registrations: Keith Sproul WU2Z, 698 Magnolia Road, N. Brunswick NJ 08902.

WinAPRS Registrations: Mark Sproul KB2ICI, 698 Magnolia Road, N. Brunswick NJ 08902.

NEVER SAY DIE

Continued from page 13

Maybe you've read about the Congressmen who call industry associations and threaten hearings unless they get money for their re-election campaigns? Oh yes, I forgot, you're too busy to read books. Besides, what can one person do, right?

Search For Intelligent Life Fails!

The $1.5 trillion (this year) search for intelligent life in Washington has totally failed. No problem, more money has been budgeted for next year. The IRS has assured us that we taxpayers will be in compliance to cover this continuing search. As Congressmen have explained about the deficit, "Heck, any business has to carry some debt. And after all, it's only a paper debt anyway. The continued foreign support of our debt means they have confidence in America. Well, we want them to have even more confidence."

Opinions

There's a big difference between expressing opinions vs. being opinionated. I enjoy hearing from readers who have opinions which are backed by solid homework. One of the problems with the Internet is the abundance of opinionated blather. Not that we don't have much of the same on some 75m nets. And that reminds me, I heard Herb KV4FZ pounding through on 20m the other morning. What does it take to get the FCC to delicense someone?

Dennis Lee

Several readers have asked me what I think of Dennis Lee and his cheap power inventions. I haven't gone to any of his demonstration/sales sessions, but I have seen his video and read his book. The book is not going to make my list of books you're crazy if you don't read. It's more a candidate for books you're crazy if you bother to read.

Here's a guy, a showman, obviously, who claims he has a great invention. It'll generate power and heat your home, making you free of the power company. It'll run your car. And so on. His book tells nothing at all about the technology. It's mainly a history of his persecution by the government and the courts, and the time he had to spend in prison. Now, I'm not used to the notion that our courts and government are right about much, but this time maybe they weren't out as far in left field as usual.

Having watched most of the big-time magicians both in person and on TV, I'm used to the idea that a good magician can make almost anything seem to happen. So the more I watched Lee's video, the more I felt I was watching a magic act, not a scientific demonstration.

I was surprised when I read that Yul Brown (Brown's Gas) would be appearing with Dennis at Philadelphia. I've watched a video of a Brown's Gas demonstration, but I didn't understand the theory of what was

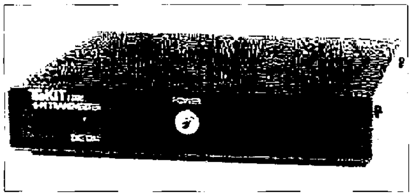
Continued on page 23

Number 20 on your Feedback card

73 Review

The Ten-Tec 1209 2-to-6 Transverter

An easy way to have some fun!



David McWhinnie VA3XDM (ex VY1DM)
281 Castor St.
Russell, Ontario
Canada K4R 1B8

If you are looking for a way to jump into the fun on 6m, the modestly priced Ten-Tec 1209 2-to-6m Transverter may be just the answer. Available either as a kit or pre-built, this transverter provides an easy route to the entire 6m (50-54 MHz) amateur band, using just a 2m transceiver. Providing access to a whole new set of FM repeaters, the unit is also a great way for Technician Class operators to get in on the fun of working DX openings, especially when used with a 2m all-mode transceiver. Add the pride that comes from using something you put together yourself, and this kit really has it all!

Construction is not difficult, requiring only basic hand and soldering tools, with an ordinary multimeter and some kind of power output meter being the only test equipment needed. I found that a simple HF SWR/power meter worked just fine.

At just under $100 US for the kit ($159 pre-built), you can have hours of operating fun for a modest sum, as well as the pride of using something you had a part in building.

Technical

Technically, the Ten-Tec 1209 is straightforward, comprised of a 94 MHz local oscillator and diode mixer to convert 2m signals to 6m (and vice versa), amplification and filter circuits, and PIN diodes for T/R switching. The T/R circuit is RF sensing, so the radio's antenna connector provides the only connection between radio and transverter.

"The unit produced close to 10 watts at the center of the band, and easily managed better than 9 watts almost to the edges of the band."

With a maximum driving power of 5 watts, this transverter produces 8 watts at 6m, making it ideal for use with most 2m handhelds. As most synthesized 2m rigs are user-programmable to handle TX/RX frequency offsets other than the standard 2m split of 600 kHz, the common 6m repeater offset of 1 MHz is easily managed. Should you have a 2m rig which cannot readily be set to 5 watts maximum output, Ten-Tec has thoughtfully included instructions on the necessary modifications to the input circuit to accommodate both higher and lower input powers.

No modifications to your radio are required. The assembly manual does strongly emphasize the importance of correctly assembling and testing this portion of the kit, which ensures proper operation of the transverter and prevents unwanted/spurious output signals.

After construction, I tested the unit using a commercial service monitor and found that it met or exceeded Ten-Tec's specifications. If anything, Tec-Tec seems to have been a bit conservative in describing the performance of their product. While Ten-Tec specifies a nominal output power of 8 watts (for the maximum 5 watts input), the unit produced close to 10 watts at the center of the band, and easily managed better than 9 watts almost to the edges of the band, only dropping off significantly at 54 MHz (the upper limit).

Input (6m) sensitivity was measured at .13V for a 20 dB S/N ratio (on FM), again slightly better than the nominal .15V specified. The assembly manual notes that this specification depends on the sensitivity of the 2m receiver used. In on-air use, the built-in preamp ensured that receive sensitivity was ample, with little or no noise noted.

Because of the inherent sensitivity of the 2m transceiver to its design frequencies, keeping unwanted 2m signals from "leaking through" and appearing in the 6m band is sometimes challenging. The 1209 meets this challenge well, with no feedthrough noted in on-air use.

The most noticeable thing on first unpacking the kit is its weight. Although it's only a little more than 7 inches (W) by 6 inches (D) by 1 inch (H), the assembled kit weighs about 2.5 lbs., largely due to the steel enclosure. If you've ever chased an aluminum box all over a table because it's too light to stay in place with the coax connected, you'll appreciate the physical stability of this little unit. As an aid to final testing and troubleshooting, the board can be temporarily installed upside down, which I found very handy. Mechanically, the cabinet, connectors and board (there's only one circuit board) fit well, and solidly. The finished product looks and feels substantial, and has none of the "second grade" feel sometimes associated with kit or home-brew equipment.

Construction

Assembly is not difficult, and would take most reasonably diligent hams between 10 and 20 hours, if my experience is any guide. The manual is well laid out, and is clearly geared for the inexperienced builder. Construction is organized into seven basic "phases," each encompassing a particular functional segment of the circuit. Each phase includes a step-by-step description of the assembly to be performed, a schematic and pictorial representations of the part of the circuit and board being constructed, and a concluding "progress test" to ensure that the steps have been completed correctly. I found this approach quite convenient, as the time required to complete and test an individual phase nicely fit the time available of an evening, once dinner was cleared, the kids bathed and read to, etc.

The manual contains many helpful hints and suggestions in addition to the extremely detailed descriptions of each individual step. Ten-Tec even provides a detailed description of each component to be installed at a given step, i.e. "Install resistor R39, 10S (brown-black-black)." While this degree of detail might be unnecessary, having both the value and the "description" may serve as a second check on the builder's selection of a given part. To further aid installation, the topside of the board is printed with component numbers and outlines, showing the correct orientation of each component.

Those who like to "roll their own" will undoubtedly be glad to discover that there is some coil winding to be done. The instructions are clear and the illustrations helpful, so the task is readily managed, even by the less experienced.

The only quibbles I had with the construction phase were a couple of missing parts, and a hook-up wire which did not stand up well. When I opened the kit a couple of 10k resistors were missing (other value resistors somehow got into the package), as was a ferrite bead required for the lead of one transistor. As they are common items, I had them on hand. However, Ten-Tec makes provision for even this eventuality in the manual, and in their warranty they promise to replace any such missing parts promptly.

My only other quibble was a piece of hook-up wire which is installed early in the assembly process. The roll supplied in my kit was pre-tinned, and somewhat brittle. With the number of times the board has to be flipped over and back during the rest of the construction, this particular wire broke off several times. Annoying, but nothing serious.

"Ten-Tec even provides a detailed description of each component to be installed at a given step."

On-air performance

Once the rig was checked out and tuned up, I hooked it up to a "quick and dirty" half-wave sloper dipole I had hung off my tower at about 15 feet, just to see if I could bring up the local 6m FM repeater. The repeater came up just fine, but no one was around to talk to, so I moved down to the sideband calling frequency (50.125) to have a listen. The first fellow I talked to, Bill K4LRX, turned out to be in Henderson, Kentucky, about 900 miles from my home QTH near Ottawa, Canada. I thought the 5 X 7 signal report was not bad for 10 watts, and a pretty poor antenna. I have since put up a home-brew three-element beam at 35 feet, and have had a fine time working stations up and down the East Coast, over to the Midwest, and when conditions permit, as far west as Oklahoma and Texas. The signal reports have been uniformly good, with many positive comments about how well this little rig does the job. Since I previously spent most of my time on packet and satellite, I'd never experienced the fun of (almost) QRP. There is a certain joy in discovering your home-brew 8W rig and three-element antenna is pulling in the same 5 and 9 signal report as your neighbor with 800 watts and six elements.

Conclusion

Obviously, I really enjoyed building this kit, and am having a ball using it on the air. Ten-Tec has done a good job with the kit itself, and I found them excellent to deal with when purchasing it. It happened that I had a couple of technical questions the salesman could not answer. Right away, I was put through to a technician, who had the answers and some helpful suggestions as well. This left a very favorable impression, and the performance of the kit has lived up to that impression. For someone looking for a reasonably low cost way to get on 6, and for an answer to some of those who dismiss "no-coders" as "appliance operators who can't build a thing," the Ten-Tec 1209 might just be the answer. It looks good, works well, and doesn't cost much. A good combination all 'round.

Number 22 on your Feedback card

Shooting Straight Up

NVIS: A neglected short-range technique.

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San Jose del Cabo, B.C.S. 23400
Mexico

The quest for long distance communication has totally captured a large segment of the ham population, to the point where multi-element antennas at expensive heights are the sign of a serious ham.

"Forgo the kerchunking and give NVIS a try."

Few things in ham radio are more thrilling than a contact with some isolated island or far-off country, or the convenience of our thousands of repeater systems. But there are times when all the long-range antennas or slick little handhelds may just not be what is required. We are perhaps best known outside our own community for the communications we provide from disaster areas when all else fails. That is just the situation where Near Vertical Incidence Skywave operation may be the winning ticket—providing reliable short- to medium-range communication as required in a disaster, or even just for semi-local contacts in mountainous areas where it may be impossible to get into a repeater.

So how can you get involved with this type of operation? By using an antenna radiation pattern that is terrible for long-range DX but perfect for local coverage, even from the deepest canyon or behind the highest hill; and that is via high angle antenna radiation.

The reason antenna height is always stressed in DX antenna discussions, and why the big guns mortgage their family jewels to purchase those big towers, is the Holy Grail of low angle radiation. Within reason, the lower the angle of radiation, the greater the distance to the first reflection point in the ionosphere and the further away the touchdown point of the reflected signal. Fewer hops make for better DX. The downside is an almost total lack of signal in the nearby skipped zone. If we take the NVIS approach, we use the opposite effect. We want our signal to cover a circle around our location to a few hundred miles out. We, in fact, want our signal to take off as close to vertically as possible.

Signals that enter the ionosphere at a suitable frequency and a very high angle will be reflected back to earth around the transmitting point. The high takeoff angle allows the signal to ignore nearby high hills, and to get into (or out of) deep canyons or gorges.

Rarely discussed in ham literature, NVIS is a standard mode used by emergency and military communicators worldwide. It is very easy and inexpensive to do, and certainly deserves to be better known, especially by groups who pride themselves on emergency preparedness.

Using NVIS

For a fixed installation it could hardly be simpler. Rule One: Forget your verticals since they excel at low angle radiation and squirt almost nothing straight up. Rule Two: Keep it horizontal and relatively low.

A dipole is probably the simplest way to go. Cut it using the usual formula for the frequency of operation and mount it anywhere from 8 to 25 feet above the ground. It can actually work fine even lower than 8 feet, but might be hazardous—people walk into the wire, which can be surprisingly invisible to someone who's not paying attention. If you have to mount the ends of the antenna higher than 25 feet or so, you can go against everything that you've been taught and let the feed point sag well below the ends of the dipole. Try to keep the included angle greater than 90 degrees as you want to raise your takeoff angle but not cause cancellation of the signal.

So, how do I handle this on my mobile, where my antennas are normally vertical? This is more of a challenge since the antenna must be horizontal, but for someone with a little ingenuity it's no big deal. In this case a larger vehicle has an advantage over the mini-compact since it has more horizontal real estate with which to play. On an RV or truck, by using 10- to 20-inch lengths of PVC tube as standoff insulators it is possible to mount a respectable horizontal doublet, if not a full dipole. On smaller vehicles, two inexpensive loaded whip antennas will work fairly well when used as the two halves of a dipole. They need not be perfectly horizontal to be useful, so they can be mounted in an inverted "V" configuration. For multiband use, two "CB" type stainless steel or Fiberglas™ whips fed with a tuner with a balanced output can be used. The military makes extensive use of these, using megabuck helical loaded whips and automatic tuners.

The whole process relies upon the ionosphere directly above the

transmitter being reflective at the frequency of operation. As reliability is the main reason for using the NVIS mode, it tends to be used only on the lower frequencies, i.e. below 10 MHz. The rule of thumb is to use frequencies no higher than 90% of the MUF for the prevailing propagation conditions. At the present low level of sunspot activity, this means 160, 80 and 40 meters are going to be your bands of choice. The later in the day, the lower the frequency. Currently at night 160 and 80 meters will probably be the most usable bands.

NVIS has proven to be a reliable means of short- to medium-range communication and belongs in the repertoire of all emergency groups. It is simple to implement and an area which has been little explored. A few dollars' worth of wire and coax or a couple of inexpensive loaded whips will get you on the air, so forgo the kerchunking and give NVIS a try.

NEVER SAY DIE

Continued from page 19

happening. Well, maybe it's my stupidity, right?

So here's Lee putting on his show in cities all around the country, selling distributorships in his magical power unit, and, as far as I know, with no manufacturing facility anywhere, or even a preproduction model of his unit. That smelled fishy to me. And now he had Brown with him, claiming that he could de-activate radioactive waste. Hmm.

Lee claims that with his technology, cars can be modified (same engine) to run without gasoline and have no exhaust. His unit will purify an unlimited source of fresh water anywhere at no cost. Garbage and sewage can be disintegrated with no negative effects. Free electricity can be produced from air anywhere in any quantity. He has the world's greatest heat storage device, the world's most efficient heat pump, and frictionless oil.

René (author of *The Last Skeptic of Science*), who lives in New Jersey, went to the Philly demo/sales show, taking along some film to be exposed to the radioactive samples before and after the Brown treatment. I know you're not going to believe this, but Lee called off the radioactive demo and René was locked out of the hall.

When I first began hearing about Lee I was hoping that maybe somehow he was on to something. The book and video didn't help. And when I called his office they said there was no one there who could talk technically to me, and that Lee was on a national tour selling distributorships and wouldn't be back for several months.

I figured that if what he was doing made any scientific sense this could be another new technology that I might be able to help grow into an industry with a publication. Always looking.

Lee's Better World Technology works out of a post office box in a small northern New Jersey town which is less than 30 miles away from René's home. René says the talk up there is that Lee's group is planning on leaving town.

If you've read about the Lee inventions or seen them in operation, let me know what you think. Since what he is selling seems too good to be true, maybe it is.

Cancer Update

In the last 25 years, though billions have been spent on cancer research, the survival of about 97% of cancer victims has not been improved one little bit. Well, you ask, how about chemotherapy? What doctors don't want you to know is that chemo doesn't work except for a few very rare types of cancer. Worse, it can cause many more problems, including even more deadly cancers.

You know, early in this century cancers were exceedingly rare. Today, one in three of you are going to have the trauma of dealing with cancer. The doctors will want to operate or use chemo, or probably both. When cancer strikes, you have a decision to make. A big decision. Are you going to put your trust in doctors and believe and do everything

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Number 24 on your Feedback card

73 Review

Woodhouse Communications' APT-2CP Omnidirectional Antenna

... and its perfect sidekick, Hamtronics' LNG-137 receiver preamp.

Larry Antonuk WB9RRT
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Marlborough NH 03455

I had completed construction of my new weather satellite receiver (see Hamtronics R139 review, *73*, November 1996), and had hooked it up to my discone antenna. I stumbled through the demodulator instructions, and had actually received and viewed lots of Automatic Picture Transmission (APT) pictures. Overall I was pleased with my success. As I began to decode more and more pictures, however, I found that I was becoming more and more critical of the results. The main problem was that the overhead passes were too short. Only rarely did I get a full screen image; in most cases I was recording a two- or three-inch picture with each pass. Even these images were broken up at the beginning and end of each display, and the pictures were cluttered with black and white spots and streaks. Something was obviously amiss, and I had a pretty good idea what it was.

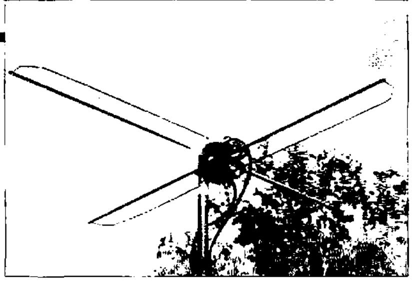
During my days as a Novice I heard an adage that has stayed with me: "A dollar put towards the antenna is worth twenty put towards the receiver." Adjusted for inflation this might come closer to two hundred dollars towards the receiver, but the message is clear. If you want good reception, you have to make sure that you capture the best signal available at your location.

Choosing an antenna system

When it came to antennas for overhead satellite reception I was somewhat in the dark. I quickly learned that there were two main paths to take. The first utilized a circular-polarized, fixed omnidirectional antenna with a fairly wide beamwidth, pointed straight up. This antenna made use of two crossed driven elements that sat above a pair of crossed reflectors, and was called a "turnstile" since it resembled, well, a turnstile. The second method also made use of a circular-polarized antenna, but a higher gain, smaller beamwidth yagi model. This was mounted on a dual rotator arrangement, to provide elevation and azimuth movement. It provided a much stronger received signal than the fixed option, but of course it needed to be continuously moved to follow the satellite as it traced its arc across the sky. There were even computer programs that would automatically turn the rotators, based on information about the satellite you fed in earlier.

I pondered my choices, and compared them to my current needs and resources. Obviously, the rotating method would provide the best coverage in borderline circumstances, and allow the most data to be squeezed from each pass. On the other hand, someone needed to make sure the rotators were turning the antenna correctly—it didn't sound like this was something that would occur automatically while I was at work, at least not without a whole lot of set-up work on my part. Besides, I really didn't care what the weather looked like when the satellite was down near the horizon—I wanted to see the picture mainly when the satellite was right overhead, which was when the turnstile antenna did its best work. The deciding factor had to do with simplicity and cost. I found that I could put up a turnstile antenna for about one-fifth the price of a yagi/rotor combination, and it looked like I could get it assembled and mounted right away.

Once I decided on the antenna I needed,



the choice of manufacturer was obvious. I had come across a catalog from Woodhouse Communications, in Plainwell, Michigan. Woodhouse has a complete line of antennas, all designed for various types of APT reception. I sent a check off to Woodhouse, requesting their APT-2CP turnstile antenna.

I received the APT-2CP about a week later. As soon as I opened the box I was pleased with the purchase. The Woodhouse folks produce a special line of antennas, and they obviously take great pains to do it right. The vertical boom of the antenna is a piece of one-inch 6061-T6 aluminum tubing. Holes are drilled through the boom for the elements—no U-bolt arrangements here. The 18-8 stainless steel solid rod elements are pre-tapped for the stainless hardware that will hold them in place—no self-tapping screws or hose clamps. The baluns are true coaxial baluns, not ferrite bead types. The balun blocks are machined from HDPE plastic for UV stability and strength. Every part of the antenna, right down to the Ampenol connectors and Belden cable, is real quality stuff.

Setting up the APT-2CP

Assembling the antenna was fairly straightforward, and was done in under a couple of hours, including time for a break. The instructions give some hints on how to support the antenna with a couple

of sawhorses; this made construction quite easy. I had started the project in the early evening, and by the time I had the antenna ready to go up on the roof it was already dark. I decided to put the project off until the next day, but I did hook the APT-2CP to some coax which I tossed through the window into the shack. I didn't get around to mounting the tripod on the roof until a couple of days later, but in the meantime I found that my satellite passes were now at least twice as long—with the antenna still sitting on the ground!

I finally got the tripod mounted, and mounted the antenna on a piece of mast with the supplied stainless steel clamps. The only advice given concerning the location of the antenna had to do with maximizing the "horizon." In other words, get the antenna as high as possible, away from and above any obstructions such as trees and chimneys. (It is recommended that the turnstile not be side-mounted on your tower, and not below your beam!) Once it was on the roof I found that my passes improved even more, and I was able to get full screen images with little problem. In addition, since the antenna was fixed and omnidirectional I didn't need to mess with it at all—I just let my R139 receiver switch on the tape recorder when a satellite was going over, and collect the passes for me so I could demodulate them and review them at the end of the day.

As I collected more and more images, I found that I got even pickier and pickier. I began to notice that there were still a few patches of "snow" at the beginning and end of each pass. The point where the satellite signal was the weakest looked like it could still use some improvement.

Improving the picture

I knew that receiver preamps were available, and that this might help improve my situation. I also knew that a preamp could actually degrade the system's performance—especially if there were a lot of strong signals around. I was somewhat near an airport, so I figured that I might be hit with aircraft transmissions, but I didn't have an excessive amount of public safety or commercial two-way traffic around the neighborhood.

My main concern was that I had been too cheap to go out and buy a quality piece of coax for the turnstile. I had used a 75-foot piece of RG-8 that I had previously used on HF, and I worried that there might be too much loss in it. I weighed the options, and figured that the preamp would be the way to go. Since I was using the Hamtronics R139 receiver, I ordered an LNG-137 preamp from Hamtronics.

The LNG-137 is similar to the LNG-144 preamp used in repeaters and for weak signal work, but tuned specifically for the 137 MHz weather satellite band. It comes preassembled, and requires a +12 VDC supply. (Hamtronics does sell a phantom power kit to allow you to run the 12 VDC up the coax, but I didn't want to mess with building up the isolators on each end. I simply ran a piece of insulated bell wire up to the antenna, and used the coax ground for -12 VDC.) I mounted the LNG-137 on a small (3" x 3") piece of aluminum stock, and mounted it to the mast below the turnstile. I made up a small jumper with the proper BNC connectors, and taped and caulked the unit with silicone sealant.

"As I collected more and more images, I found myself getting pickier and pickier."

Testing with the preamp in-circuit showed improvement at the very beginning and end of each pass in the form of fewer of the black and white "dropouts." So far I haven't noticed any evidence of any of the problems associated with too much gain—intermod products, oscillation, etc. However, in my case, the use of the APT-2CP antenna (designed specifically for 137 MHz) as opposed to a broadband antenna will limit the strength of the out-of-band signals that are passed to the preamp. And the preamp, being tuned to 137 MHz, will favor those signals over out-of-band signals, as well. (If intermod signals do become a problem, I know I can add even more selectivity with a helical preselector, tuned to 137 MHz.)

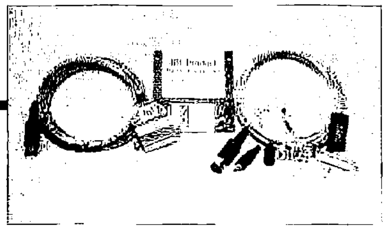
The Hamtronics LNG-137 preamp and the Woodhouse Communications ATP-2CP turnstile antenna have proven to be a very straightforward, low cost approach to weather satellite imaging. The ATP-2CP is available from Hamtronics, Inc. (716-392-9420) or directly from Woodhouse Communications (616-226-8873).

73 Review

Number 26 on your Feedback card

JBI Universal Radio Interface Kit

A great first-time project!



Shane P. Brady WB2WPM
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You just can't beat having your radio talk with your computer for keeping your log straight and for contests, for passing on information such as time, frequency and mode, but obtaining a circuit board for such projects and even getting parts has been challenging. Lots of ideas have appeared in various publications for home-brewing your own interface, and of course you could purchase your radio's manufacturer's interface from them. Unfortunately, most OEM interfaces are in the $100+ category!

"Would I buy another one? Yes—that's exactly what I did."

For six years now, my station has had my Kenwood TS-450 (and before that the TS-440) interfaced with my computer logging program, Log-EQF. While at Dayton this year, I picked up a new IC-706. As I walked around with my new purchase, I was contemplating how to do the interfacing, knowing how lost I would be without a computer talking with my new radio. It just happened that I was at the Log-EQF booth when I noticed the interface they were using—a JBI Universal Radio Interface. Before leaving the booth I had the opportunity to meet John Bechtoldt, the owner/developer of the interface, who had stopped by to say hello. John told me that his interface worked FB with the new IC-706. When he told me the price, I was sold!

The JBI Universal Radio Interface Kit will interface virtually any modern radio (with computer interfacing capabilities) to a standard RS-232 port. This includes just about all the Kenwood, Icom, Yaesu, Ten-Tec, and even the Heathkit SB-1400 radios. While the interface is a stand-alone addition, a few radios do require some internal modification. This you must do yourself, and is not part of the kit. When ordering the kit specify which radio you have so the appropriate cable and plug will be included. The rest of the kit is universal.

About 10 days after ordering, a large brown padded envelope arrived. I was rather surprised at how few parts there actually were. Aside from some capacitors, resistors and diodes, there is only one IC to round out the electronics package. The remaining items are a PC board, DB25 female connector, multi-conductor shielded cable and, depending upon which kit you ordered (Kenwood, Icom, Yaesu, Ten-Tec, Heathkit), the appropriate plug to match your radio—plus a very nice DB25 die-cast hood which eventually will hold all components!

Assembly

Assembly is smooth and quick, and could be a perfect first-time project. The instructions are straightforward, and include illustrations of how the finished PC board will look for each radio. The assembly instructions start off by having you insert the PC board in between the two rows of pins of the DB25 connector, and then soldering them in place (there are only seven pins which actually require soldering). As you are led step by step through assembly, you'll be told to skip certain instructions for certain radios, and to complete the steps for *your* particular radio. Depending upon which radio you are interfacing to, you may have an extra capacitor or resistor left over. Remember, this is a universal interface so you get all the electronic parts for *all* the various radios.

For installing components, the PC board has been properly lettered so you know which component goes where. The large illustrations provided take any guesswork out of where a capacitor or resistor belongs. The illustrations even show the position of the "banded" ends of the diodes, so you can't install them backwards.

The 16-pin IC is installed just about last; it's static sensitive—there's a warning to that effect in the instructions. Caution should be taken that you and your surroundings are all at the same electrical potential, so as not to destroy the chip with static. This installation does not use a socket, so you must solder all leads directly to the board. You shouldn't run into any trouble as long as you don't apply too much heat or make any solder bridges.

One final step: Before putting the assembly into the die-cast hood, attach the shielded cable to the PC board. This is the only place I had any reservations as to which wire went where. The instructions are written around a four-conductor shielded cable. The IC-706 only uses two conductors. A two-conductor cable was supplied with my kit, but wasn't mentioned in the instructions (I have since spoken with John Bechtoldt, and he informs me that this modification to the instructions has been addressed). With the cable wires soldered into the proper holes, it was time to button up the hood.

There *was* one personal modification. Experience has taught me to take the precaution of installing toroidal (ferrite)

cores on all radio and computer cabling in the shack, usually one core at each end of a cable. This step has eliminated the annoyance of inter-equipment interference, and I recommend it to everyone. After putting the halves of the hood together I put a couple of turns on a toroidal core, locating it up close to the hood, adding another core at the free end of the cable. The final step was to install the 1/8" miniature phone plug, which mates with the radio, on the free end of the cable.

Features

JBI also includes a 3-1/2" disk containing a number of DOS programs for rig control, so you will be able to test things right away. Having Log-EQF already on my computer, I used it as my test software. Anyone who has built anything knows the anxiety and dread just before adding power to a project to see if it actually works. I attached the interface to the computer and the radio, turned them on—and the logging program proudly announced it was talking to an IC-706 and showed the appropriate frequency and mode. A spin of the frequency dial and the computer followed along. Success! I was very pleased with the results: no interference, no hesitation—everything worked as expected.

One of the nice features of the JBI interface is that it requires no external power. Next to my Kenwood radio sits the Kenwood interface box, complete with its 12 VDC power plug that I've used for a number of years. Any time I can eliminate some congestion at the operating position I'm all for it, so it was only another week before off went another order to JBI—this time for a Kenwood interface kit. The second kit was identical to the first, with the exception of the six-pin DIN plug that matches Kenwood radios. Assembly was completed on this interface in less than half an hour. It too worked the first time and has performed flawlessly since. It is so convenient not to have that extra power lead running around the back of the station; the old Kenwood interface box, which required the external power supply, will be on my table at the next hamfest.

Currently, JBI Products and Technologies offers their Universal Radio Interface Kit three ways. The first is the interface kit, a genuine bargain, currently listed at $29.95. Manufacturers' interfaces run three to five times as much. Those who are leery of soldering a couple dozen connections may purchase the interface completely assembled, for a current list price of $45.00. The final option is an assembled interface but with the addition of a CW keyer option, at $59.00. The CW keyer option allows many logging and contest programs to key the radio via the computer keyboard. (Shipping and handling are not included in the above prices).

The instructions would be nicer if they were organized straight through for one radio, instead of skipping paragraphs for radios you aren't concerned with, and it would be nice to have included instructions for adding the CW option on your own—but if you want to add the option it really isn't that difficult. Most software programs such as CT and Log-EQF include the instructions for the small keying circuit, which only requires one transistor and one resistor. There is plenty of room in the DB25 hood for this CW mod. I recommend that you spend the extra five minutes on it.

I guess the final test as to would I recommend this kit would be, would I buy another one? Yes—that's exactly what I did.

For details and ordering information, contact: JBI Products and Technologies, 1418 South Yale Drive, O'Fallon IL 62269-2738. 73

NEVER SAY DIE

Continued from page 23

they say? Or are you going to fight back, educating yourself about your cancer and the alternatives open to you?

My advice, which I know most of you are going to ignore, is to do two things. First, do your best to make sure that you don't get cancer. I'm now convinced that cancer is 100% avoidable if you educate yourself by reading the books on health which are on my recommended book list (available from Radio Bookshop). Read, then make changes in your thoroughly ingrained habits which are slowly killing you. If you'd rather die than change, fine—you will. Second, if you don't change so you can avoid cancer, once it hits you can get my reading list and belatedly do your homework. Maybe by then you'll be ready to change your habits. Read the books by Drs. Comby, Wallach, Huggins, Batmanghelidj, Coca, Douglass, about Essiac, L214, and so on.

If you keep your immune system strong you aren't going to have cancer, heart trouble, and any of the chronic illnesses which beset about 99% of older people.

Continued on page 29

Build This 6m Attic Antenna

A simple stealth antenna project.

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A local ham, knowing that I love to make different types of antennas, asked if I could make a shortened 6 meter vertical dipole for him to use in his condominium. Due to his covenant restrictions, his ham antennas have to be indoors and out of sight. I had been doing some reading on helically-wound antennas and told him to give me a week to get the bugs out of the design. With just over eight feet of height to work with in his crawl space, we didn't have to shorten the antenna very much. I came up with a seven-inch spacing between turns so that the antenna would not have a lot of inductance.

The problem with making a helically-wound antenna is that to figure the length of the dipole you must add about 5% to make up for the inductance created by the coil. Also, you'll have less bandwidth with a more compressed coil winding. *The ARRL Antenna Book* states that there are no exact, predictable results when winding shortened antennas. Wire diameter, coil diameter, and compression of the coils all interact with each other.

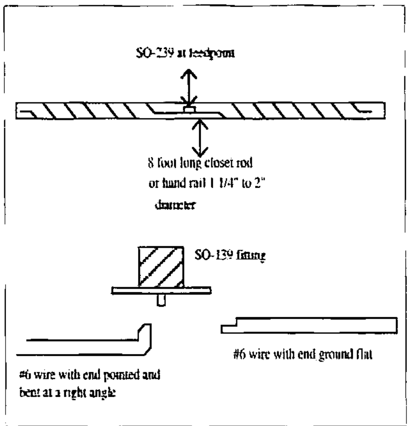

Fig. 1. Shortened helically-wound vertical dipole for indoor installations in your attic or crawl space. (Drawing not to scale.)

This antenna covers the 52 to 54 MHz portion of the 6 meter band. It has an SWR of 1.3 or less, with a smooth SWR curve.

My design is built using a piece of fir closet rod from the local building supply, and some #6 solid copper wire of the type used in wiring houses. The only other parts were an SO-239 panel-mount fitting for the feed point and a couple of screws to attach the SO-239 to the closet rod. I knew that a quarter-wave section of RG-59 coax for a balun would also be needed, to match the 72-ohm dipole to 50-ohm coax.

"With just over eight feet of height to work with in his crawl space, we didn't have to shorten the antenna very much."

OK, let's build it!

I started building this antenna by cutting the #6 solid copper wire into two equal pieces slightly longer than needed, to allow for fine-tuning the antenna. This antenna was planned for use in the FM section of the 6m band, so a 57-inch length was good to start with. Using my bench grinder, I ground one end of one piece of the copper wire to a taper to fit the center terminal of the SO-239 fitting. Then I ground one end of the other piece of copper wire flat to create an end that

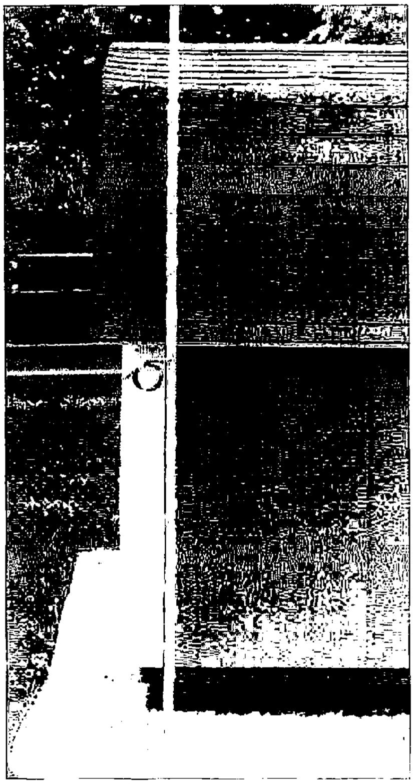

Photo A. The completed 6m attic antenna.

would be more easily attached to the flat surface of the body of the SO-239 fitting. I enlarged two of the SO-239's four mounting holes to ease attaching this fitting to the center of the closet pole. Bend the tapered end of the wire at a right angle to make a neat connection to the SO-239 fitting. Get out your soldering gun and flux to attach the ends of the wire to the SO-239 fitting. This will require a *lot* of heat; my gun is a 350 watt model and was just big enough. Once you have attached both of the wires soldered to the SO-239 fitting, allow it to cool completely before cleaning the excess flux off the surfaces.

Winding the antenna

Now comes the tricky part. I had my wife hold one end of the closet rod and wire while one of my sons held the other end, leaving me with both hands free to wind the wire tightly on the closet rod, using the width of my hand as a guide. I taped this end down before winding the other half. When I was satisfied that the two sides looked equal, I taped this side to the rod, leaving at least six inches straight on each end for tuning the antenna.

Next, make a quarter-wave line section of RG-59 coax to change the 72 ohm impedance to a more usable 50 ohm impedance. Most RG-59 coax has a velocity factor of .66 or .79. The formula found in most ham radio books is 249 divided by the frequency in MHz times 12 for a quarter-wave length in inches. RG-59-A foam coax with a .79 velocity factor is what I had on hand, so my line section was just over 45 inches long. I stripped the ends and installed a PL-259 fitting on each end of the coax with UG-176 type reducers. I wound the quarter-wave line section into a coil, taped it together (see **Photo B**), and installed it at the center of the antenna.

Tuning the antenna

I tested the antenna under conditions similar to those where it would be used, taking care to keep it away from metal objects and other dense masses which might detune it. Using an SWR bridge capable of working at 50 to 54 MHz, I took readings at each end of the desired frequency of operation. Using diagonal cutters, I trimmed the same amount off each end of the antenna, rechecking the SWR after each cut until I had a good match. I ended up with 55.5 inches on each side of the shortened dipole. The match on my antenna was 1.25 at 52 MHz and 1.1 at 54 MHz, with a dip to 1.05 at 53.5 to 53.75 MHz. I used a file to smooth the dipole ends to prevent a corona effect.

Builder's notes

You may want to paint or varnish the wooden rod before construction to help seal the surface against humidity and to keep it from warping. If you can't find #6 bare copper wire you may use #8 wire instead, or copper tubing of about the same diameter. Try to leave at least six inches clearance at each end of the dipole to avoid detuning the antenna. The reason I didn't use a torch to attach the #6 solid copper wire to the SO-239 fitting was that the heat of the torch would damage the insulating section of the fitting.

Readers who have questions about this antenna may write to me at the address above, including a #10 SASE, and I will answer by return mail.

Parts and Tools

- 8-foot fir closet rod 1-1/4 inches in diameter (this can also be a larger size of handrail)
- 114 inches of #6 solid copper wire
- SO-239 panel mount fitting
- 2 PL-259 fittings, with UG-176 type reducers for the balun
- RG-59 coax, 40 to 48 inches long, depending on the coax velocity factor (see text)
- Large diagonal cutters or a hacksaw (to cut the wire)
- Solder and flux
- Good hefty soldering iron or propane torch
- Screwdriver
- Electrical tape
- Grinding wheel (or use a file)

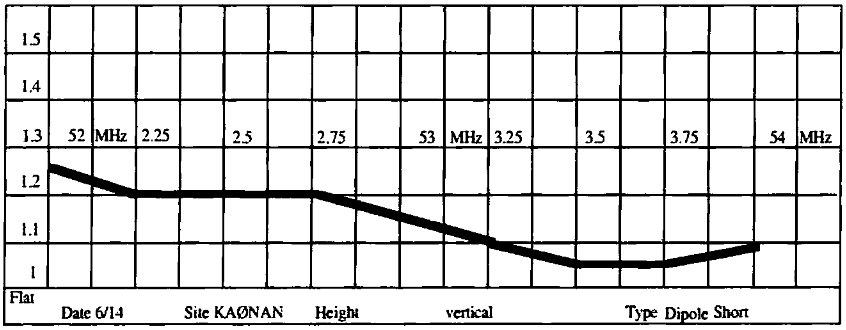

Fig. 2. SWR curve. Please use an SWR meter designed for use with accuracy at these frequencies.


Photo B. Close-up.

NEVER SAY DIE

Continued from page 27

Oh, I give up. I've been telling you this over and over for months and I'm just not getting through. Go ahead and end up in a nursing home in your 70s. Or buried.

I know, you want me to write about working DX, contests, antennas, and stuff like that and you wish I'd stop pestering you about our so-called health care system. You enjoy smoking and don't believe that you are going to be one of the 400,000 a year who die as a result. You enjoy beer and Big Macs and never mind that big constipated gut hanging over your belt. You enjoy these things more than life itself.

Hey, please write and tell me to stop being a scold about this and to get back on the air and swap signal reports with a few hundred retired old men.

QSLs

How original and creative is your QSL? How much time and effort have you put into having it represent *you* and your interests? But even a plain vanilla QSL beats the heck out of none. In looking through my cartons of QSLs the other day, they brought back

Continued on page 38

Circulators, Anyone?

Keep the traffic flowing.

Byron Mobus W6OIU
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Cameron Park CA 95682-8517

I answer my phone and the manager of the site where our repeater is located tells me that the site is being rearranged. All of the amateur repeaters are to be relocated into one building—the one where our repeater has been located since 1947. Under the new arrangement, the six amateur groups will be responsible for the upkeep and operation of the building, including sharing the costs and electricity. We've had a free ride for many years, but financial realities are about to catch up with us.

Our repeater, W6AEX on 147.27 MHz, is owned and operated by the Society of Amateur Radio Operators (SARO), and the late owner of the mountaintop, Tom Bayley W6NQJ, was a longtime member. Tom made provisions giving us use of the site for as long as the club wanted to have a repeater. We were located in the smallest building on the site, with two commercial operations; one on low band and the other in the microwaves. There was no apparent problem with interaction between the equipment in the building, so we operated with a duplexer and a single antenna on the tower.

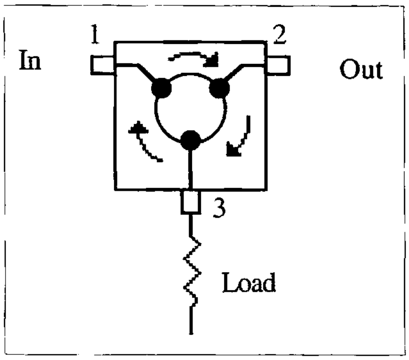

Fig. 1. Single-stage isolator.

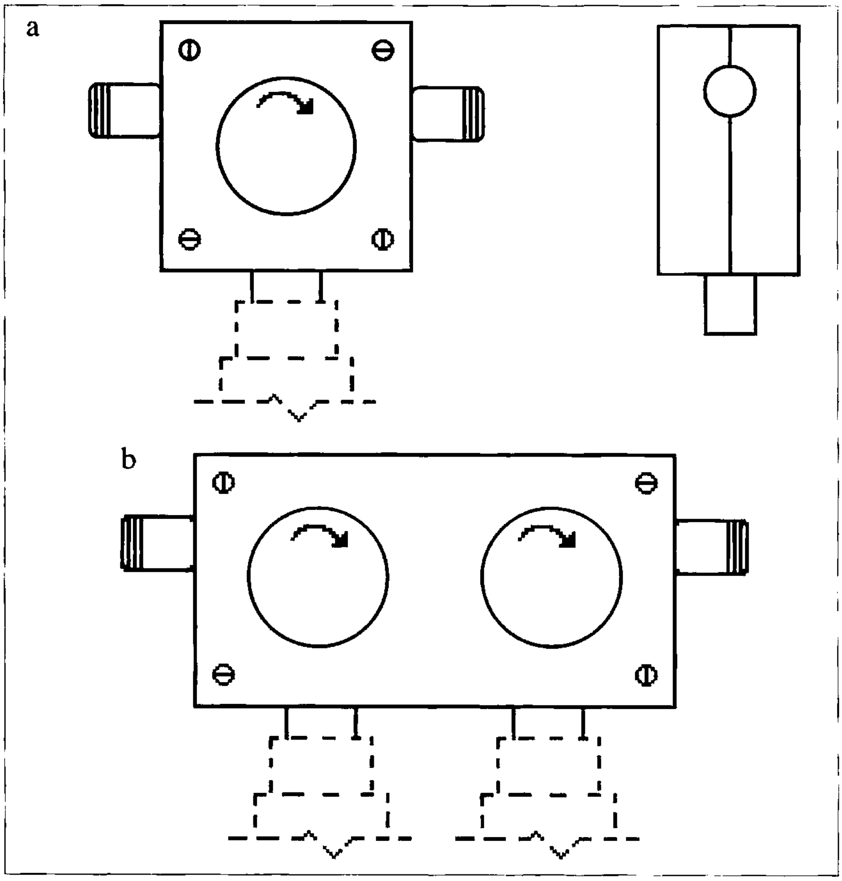

Fig. 2. a) Single-stage isolator; b) Dual-stage isolator.

Under the new regime, there would be several repeaters in the 2 meter and 70 cm bands all operating together in the same building and on the same tower. In an effort to streamline the operation, several big changes were to be made to the equipment to minimize interaction and to keep the noise floor as low as possible. There would be common receive antennas with distribution and amplification to the appropriate receivers. Each transmitter would have its own antenna. One major change was the addition of circulators to the output of every transmitter.

What are circulators?

Circulators? What are they? As a former communications technician for a major oil company, I have maintained microwave equipment that used

circulators, but they never broke so I never paid much attention to them (my philosophy is: "If it ain't broke, don't fix it!"). I started looking around for information on circulators and found less information available on them than on duplexers, which means it's pretty scarce. A friend had a 250 watt circulator for the 150 MHz band which he made available, so I set out to learn what I could about their operation.

A circulator is a device with three or more ports in which RF energy is conducted in one direction with little loss, but exhibits a high attenuation in the opposite direction (**Fig. 1**). There are single-stage and double-stage circulators (**Fig. 2**), your choice depending upon the amount of isolation and insertion loss you require. This is done by arranging ferrite material to provide a high magnetic field through the RF conductor.

RF energy introduced into port 1 is transferred to the antenna at port 2 with more than 30 dB loss to port 3, which is terminated with a dummy load. With 100 watts at port 1, almost all of the power is available at port 2 and less than 0.1 watt goes to the dummy load. Any power returned from the antenna by either an unbalance or the presence of a close-by high power transmitting system is circulated to port 3 and the dummy load. The presence on or near the site of a commercial FM transmitter with an effective radiated power of 250 kW to 500 kW can present an appreciable amount of power to the output of a communications transmitter.

A circulator is a little like a traffic circle with several streets coming into it. As you (transmitter output) enter the traffic circle (input port) en route out of town, the traffic is circling in one direction. You circle in this direction until you reach the next street (output port), then you exit. Traffic (reflected power, received signals, etc.) entering the traffic circle from the street you exit on moves in the same circle direction to the next street where it exits and enters a parking lot (dummy load). This traffic could be from out of town (received signals), or even returning traffic (reflected power) turned around by a problem down the street such as a bridge out (broken coax) or a tree down (shorted antenna). The orderly flow of traffic is ensured by the police (magnetic field) enforcing the law.

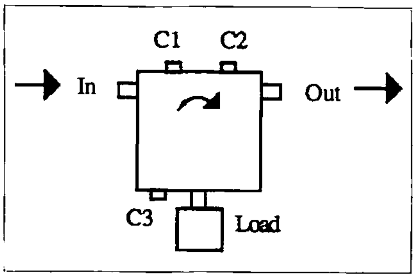

Fig. 3. Field-tunable circulators usually have three tuning adjustments.

Tuning

Field-tunable circulators usually have three tuning adjustments (**Fig. 3**) and the unit is tuned by using a very accurate signal generator and spectrum analyzer or a network analyzer (**Fig. 4a** and **4b**). A 6-10 dB pad is added to the test setup to minimize VSWR reflections in the test equipment. The signal is sent into port 2 (output) and measured at port 1 (input) with a dummy load on port 3. C3 is adjusted for a minimum transfer. The generator is then hooked to port 3, measured at port 2 with the dummy load on port 1. C1 is adjusted for minimum. The generator is then hooked to port 1, measured at port 3 and the dummy load on port 2. C2 is adjusted for minimum. Finally, the generator is hooked to port 1, measured at port 2 with the dummy load on port 3, and the insertion loss is measured.

The circulator I had was tuned to around 160 MHz with no provision for tuning, so I took the covers off. There were pieces of iron attached around the outside of the magnets and when they were removed, the tuning frequency dropped to the 140 MHz range. By careful addition of pieces of iron around the outside of the magnets, the unit was tuned to 147.27 MHz. Unfortunately, when the forward loss was measured, it was around 3 dB, which probably explains why the unit was discarded in the first place.

The unit was further dismantled and I found a triangular brass plate mounted between two big magnets with a connector attached to each apex of the triangle. This was sandwiched between large magnets with heavy iron covers. The ferrite material was badly broken, probably from being dropped, possibly accounting for the poor performance. An identical circulator was located and the tuning procedure was used to put it on our frequency. This time the insertion loss was only 0.2 dB.

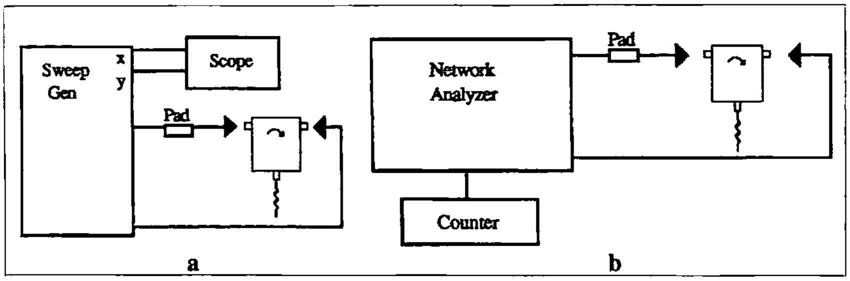

Fig. 4. The unit is tuned by using a very accurate signal generator and spectrum analyzer (a), or a network analyzer (b).

It was installed, along with a cavity, on our repeater. Ferrite isolators are subject to certain nonlinearities and may conduct or generate weak signal harmonics. To protect against second and third order intermodulation harmonics, a low-pass second harmonic filter or cavity is used between the isolator and the antenna. At microwave frequencies, circulators are used instead of duplexers. A circulator might be used at lower frequencies if the isolation is adequate, depending on the transmit and receive frequency separation, but the cost difference between a duplexer and circulator would then become a factor.

In the meantime, an isolator was ordered tuned to our frequency and power, and when it was received it was substituted for the borrowed unit. With other improvements—better grounding, tower bonding, rack bracing and painting—the site looks better and the repeater appears to be working better. At least, there has been no apparent degrading of the repeater from the addition of all of the other equipment in the building.

Hams on the Radio Information Highway, Part 2

How you can easily find and start using Usenet newsgroups.

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Last month I told you about my discoveries on the World Wide Web (WWW) portion of the Internet and about getting hooked up to do the same yourself. I think the number one reason the WWW so intrigues people is that once you get the hang of it, it's easy to move from site to site and find treasures in ham-related up-to-date information. This month, we are going to check out one more part of the Internet where hams have set up house, and I'll to show you how easily you can do it.

Let's explore the Usenet newsgroups. You are not alone if you have heard the name "Newsgroups" but aren't sure exactly what they are. The easiest way to get the picture is to compare it to a forum on CompuServe, America OnLine or one of the other major on-line services: People with similar interests gather and answer each others' questions, or just chat.

One way to imagine what the newsgroup world is like would be to assume that your town has five groups of people, each group with a different interest; also let's say your town has five repeaters and all these groups consist of hams.

It would be pretty simple to assign each group a repeater and a time to get together. This could work. I have never heard of it, but even if it were put into practice, it wouldn't compare to the possibilities of the computer bulletin board or Internet.

Where we spoke of five special interest groups getting together, that was OK, but what happens when there are several hundred—or several thousand? The "thousands" number is the extent covered by the Internet newsgroups, and they reach worldwide. Although only a small part of that is devoted directly to ham radio, many other areas hold related interests for everyone.

Let's look at what is found in the ham radio newsgroups and the basics of getting in on the action. When you get this under your belt, perhaps you'll feel quite comfortable exploring the rest of the Internet. To give you an idea about which newsgroups are ham related, here are a few of the newsgroup names (think of them as addresses):

rec.radio.amateur.antenna
rec.radio.amateur.equipment
rec.radio.amateur.space
rec.radio.amateur.misc
rec.radio.amateur.digital.misc
rec.radio.amateur.homebrew
rec.radio.amateur.policy

The names of these newsgroups are chosen carefully so they will be intuitive to you. You probably can understand what most of the above means with no explanation. The "rec." simply stands for recreation.

There are several other basic groups. For instance "comp" stands for computer and "sci." refers to science. Within the ham newsgroups, anything with a "misc." is obviously a catchall and "policy" covers subjects like no-code and other perennial topics.

Now the question is, "How do I get these newsgroups with the software we described last month?" I must admit I was a little intimidated when I decided to write this using a brand-new version of a program that is still in its test and development stages. The company (Netscape) has experienced some hitches during the development, but I think this version (2.01) does the trick.

I have heard complaints about 2.0, yet I used 1.2 prior to this for most of a year and it was excellent. As of this writing, there are already upgrades available for download. It is at least as difficult to keep abreast of the changes on the Internet and its component software as it is to attempt to explain how to program a new HT. (I keep my manuals handy for programming those "intuitive" little machines.)

Netscape 2.01 comes with a raft of bells and whistles that I was sure would be difficult to understand, but the folks at Netscape did something I really like that takes the edge off the learning curve. They do not at this time have a help file built into the program, but if you go to the "Handbook" button and

click on it, you will be connected directly to the Netscape homepage.

There you will be introduced to a voluminous manual that you can scan through and/or download and print for yourself. It comes in sections, so I printed the part needed for using newsgroups and E-mail. This current documentation is an improvement over past instructions furnished by the company. One thing Netscape makes possible is the "Save as" feature. You can select "Save as" from the file menu and specify the directory in which you want to store the Handbook, or any web page, and you will have it to read or print offline. You can open your saved file into Netscape as long as it can find "windsock.dll" or you can import it into a word processor.

New adventures

Last month, I mentioned that the *Yahoo!* search engine will also explore the newsgroups to aid you to find those to fit your interests. I suggest that if you wish to do this and you have found your way to the Netscape search engine page by clicking the "Search" button, you just need to go a few steps further.

If you will scroll down Netscape's search engine page below the prominent choices of five search engines, you will discover lines you can click to go directly to such sites as *Yahoo!*

Click on *Yahoo!* and it will look similar to **Fig. 1**. You will notice that to the right of the box where you would type in "amateur radio" there is a line that reads "options." When you click there, a list will appear that includes "newsgroups." Select that and your search will give the results of a newsgroup search. You have conquered another area of the Internet.

Here are a few pointers to help you get started on the road to success. First, you need to know there are three basic screens you are going to use as you communicate on the Internet: The Web Browser screen, the Mail screen and the News screen (for newsgroups).

The Web Browser can be found in the File menu and the other two are available in the Window menu. Also in the Window menu are two other screens; one for Bookmarks (so you can easily return to an informative website at a later date), and another to display E-mail addresses you consider worth keeping.

The newsgroup screen will look like **Fig. 2** when you open it. You will need to have your connection made to your server. Click on the newsgroup in the upper left panel and hit an "Enter" to get the program to access the net and retrieve the news messages for the newsgroups you "subscribe" to. The panel borders allow you to adjust them to your preferences by clicking on them with your mouse.

As you discover more newsgroups that interest you, you will want to add them to the list. You will find "Add newsgroup" in the file menu, and upon selecting it, you'll have a pop-up screen. Enter one of the newsgroups "addresses" (example: "rec.radio.amateur.equipment").

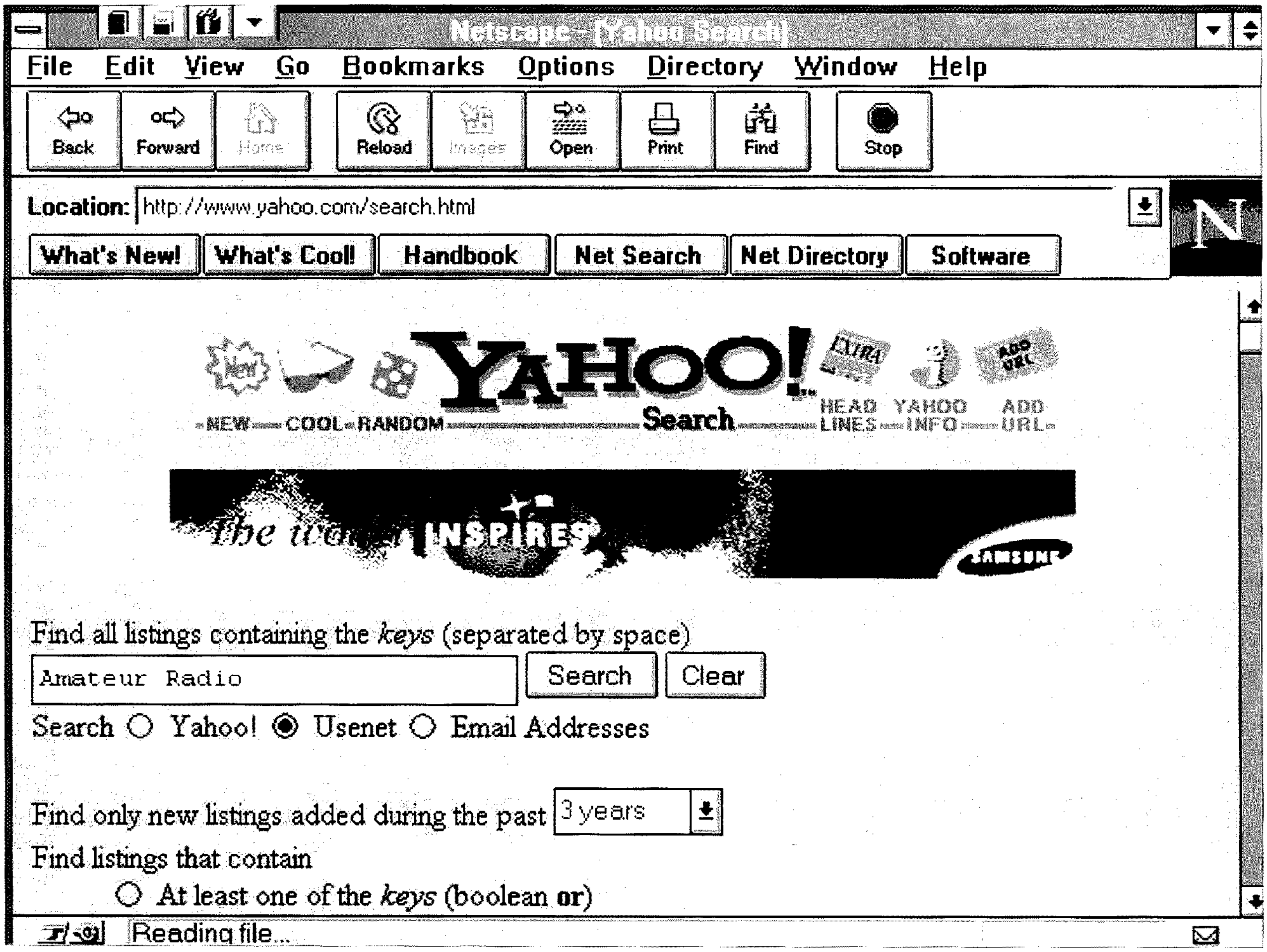


Fig. 1. Search engine (http://www.yahoo.com) with newsgroup choice selected.

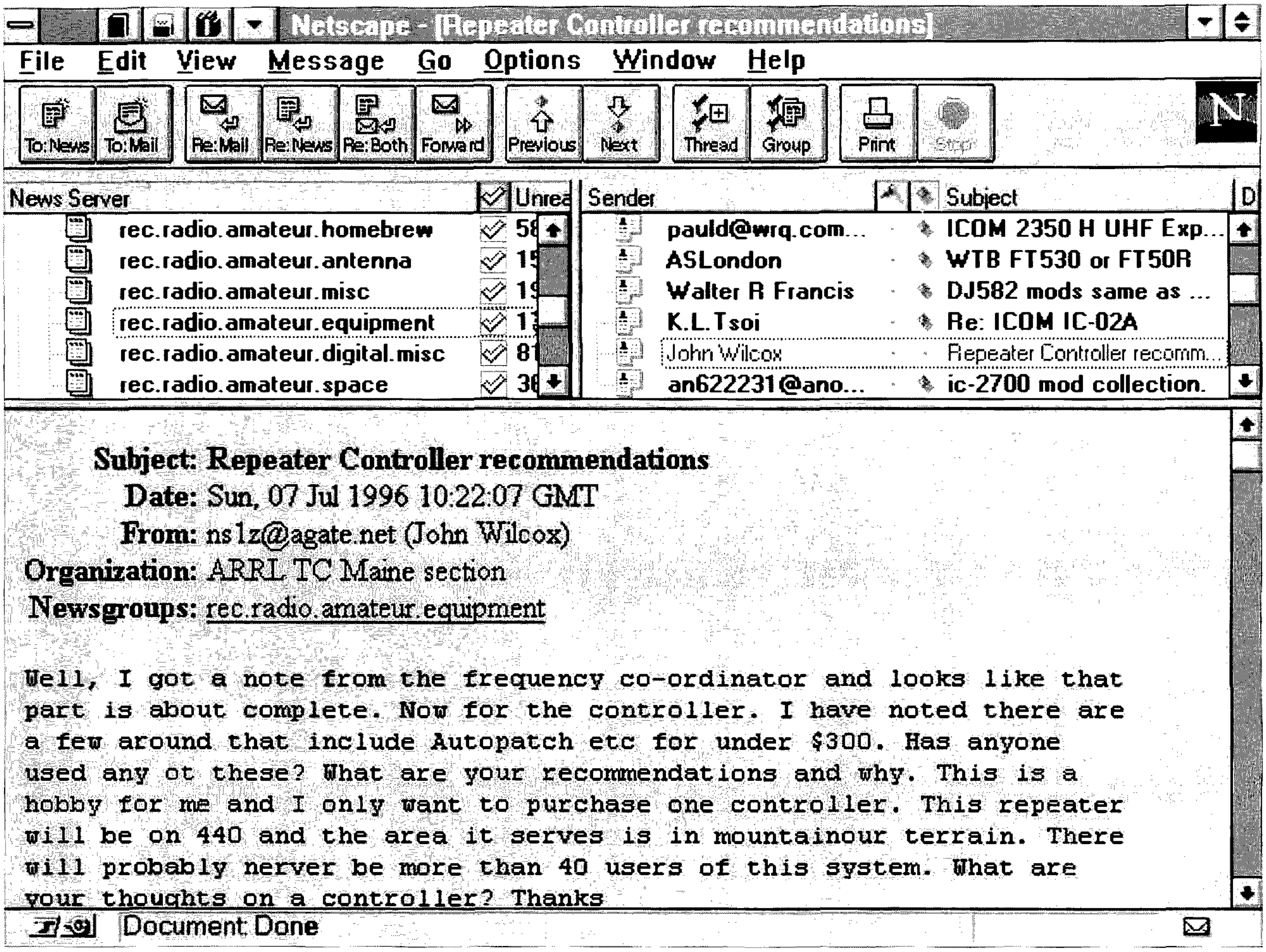


Fig. 2. The upper left panel shows the newsgroups and the number of messages. Upper right are the headers of the articles in the selected newsgroup. Lower panel is the selected message. You can change the panel borders to suit yourself.

Press "Enter" and the program will access the net and retrieve messages. Click on the line you just created in the upper left panel and you will see a list of headers in the right panel. Pick one, click on it, and the message will show in the lower panel. You are on your way! (I noticed a disconcerting thing happening the first few times I did this. When I shut down the program and came back, my freshly installed newsgroup would vanish. After careful study of the Handbook, I found I needed to click *on the check marks* in the upper left panel as seen in **Fig. 2.**) You will also want to study the various choices in the Options menu. They affect what is displayed in the upper left panel.

Now on to the fun stuff. The spirit of ham radio is alive and well on the Internet. One of the great advantages is having a place to go where your area of interest in the hobby can be addressed, and there are numerous hams who come back, sometimes within a few hours, with helpful hints.

You will find messages posted about subjects all the way from old-time radio to high-speed modems and spread spectrum. I even ran across a few queries that I posted a suggestion for. One thing is obvious—the amount of ham activity is such that the message board spans a period of just a few days, about a week. This means the same messages don't appear time and again, and if you need to communicate, you must not hesitate.

As you read the messages posted in the newsgroups, you find many references and often clickable links to web or FTP sites for current information that you may not have come across any other way. One example was a message that contained an easy link to a website containing information about digital mode software. There are numerous such opportunities; you just have to look to appreciate what is available.

Another familiar aspect of ham radio is obvious on the net—courtesy. Every message I've read is positive. No one is derided for asking a "stupid" question. Even when someone of a lower intelligence group posted an offensive profane message, it was handled with utmost politeness and refusal to sink to the level of profanity that had been posted, typical of the ham community.

Yes indeedy—vulgar language does exist on the Internet. What you might see in the ham sections will likely be posted by a non-ham who desires to cause an uproar. The practice doesn't seem to be prevalent, but I don't think there is a way to control childish pranks. Perhaps the Internet sages will come up with a method that would be less disastrous than a government attempt at regulation.

On an upbeat note, you may have enjoyed the experience of having someone give advice over the air that results in an instant fix of an equipment problem. The chances of this happening over the air are slim, due to limited exposure to those who may be able to copy us or have any interest in "reading our mail."

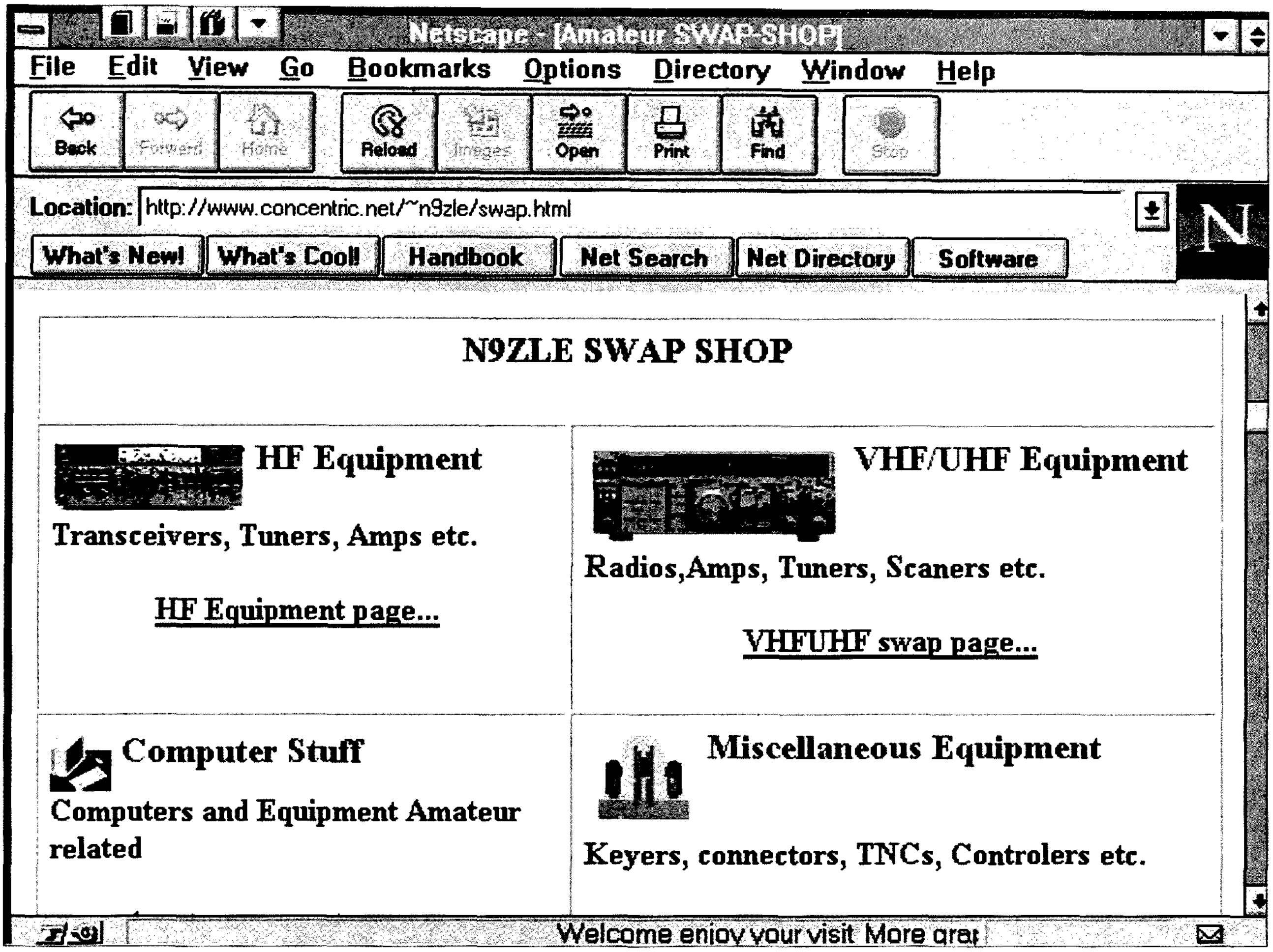


Fig. 3. One of the various swap areas on the net, referenced from a newsgroup posting.

Chances improve exponentially when you talk to a captive audience such as in a newsgroup.

The Internet is one more place where you will find and can join with hams buying and selling equipment (**Fig. 3**). There are several swap areas you will run across (they become obvious) and there is always the chance of striking a good deal. There are many hams looking for equipment that might just be sitting around in your shack.

If the idea of this massive media intimidates you, you are not alone. The number of new folks signing on every day must be astronomical. Quite a few of them, outside the ham areas, are leaving messages begging for E-mail just to see "if it really works." It's reminiscent of the first time on the air for many of us.

Folks who feel insecure with a new medium are justified in their fears, I feel, when they have jumped into an E-mail or newsgroup arena where they feel no common bond. When you, as a member of the vast ham radio fraternity, log onto a ham newsgroup, you are right at home among friends.

73 is accepting manuscripts for the June 1997 Field Day Issue.

If you had a good time at that last Field Day, or have ideas about how to make Field Day a big success, submit your manuscript on a 3 1/2 inch disk, along with a print out and photos, by the end of February, to Joyce Sawtelle, 73 Amateur Radio Today, 70 Route 202 North, Peterborough NH 03458.

NEVER SAY DIE

Continued from page 29

vivid memories of the people behind the cards, many of whom I got to know personally.

Take for instance the KV4AA card. Tens of thousands of hams will never forget Dick Spenceley's machine-like fist from St. Thomas. This card confirmed a contact with me when I was operating from Curacao, where I was visiting PJ3CC, who ran a vacation hotel which included scuba diving and a ham station, sitting atop a cliff overlooking the Caribbean. How could I not go there?

I first got to know Dick when I inherited him as my DX editor when I took over as editor of *CQ* in 1955. It didn't take long for me to find an excuse to fly down and visit Dick and his wife Anna, and to work a little DX with his Johnson KW rig. I also got in some great diving and found a horse to rent so I could ride around the beautiful Magan's Bay area. I rented my diving equipment from Leslie Caron's father, who ran a dive shop there.

One of Dick's friends, another KV4, had a little plane, so I was able to take some marvelous pictures of the island. Then there was the six-pound lobster I speared which provided dinner for the whole Spenceley family.

Well, you're tired of my ham memories, so how about you? Dig into your old QSLs and tell us some stories that they bring back for you. Don't forget to send me a disk copy. No, I won't lose your QSL.

Like the time I visited VK6RU in Perth in 1966 and he whipped out my QSL from 1946. That was during my ham African safari trip, where I continued on around the world after shooting anything that moved in Kenya and visiting Robbie 5Z4ERR in Nairobi. I hope you can get even a fraction as much adventure from hamming as I have. Hey, it's there, waiting for you, but you have to make the first move. The brass ring is out there, but you have to lean way out to grab it. If your QSL file doesn't bring back memories of ham adventures, maybe it's time to kick yourself in the butt. And don't give me any of that "Gee, I can't afford something like that" baloney. Money is easy to make once you know the secret and are able to try a new paradigm. Or is one digm enough for you?

I can point the way, but I can't force you to make changes in your life. Yep, change sure is difficult to make. But the world is constantly changing, whether you do or not, and it's going to leave you behind, fussing about things, but never really doing anything about them. Ooops, there I go preaching again. Sorry about that. The hams with rusted-in attitudes say, "There goes Wayne, bragging again," when I tell about my adventures. The few hams who are still not brain dead say, "Hey, Wayne's right, I *could* do that!"

My $5 book, *Making Money, a Beginner's Guide*, explains the secret. I should charge $5,000 since I know gratitude is one of the least felt of all emotions. The demand for the book has been brisk, as a result of my May appearance on the Art Bell W6OOB radio show, and then its repeat broadcast in August. The nice part for me is that I'm already getting letters thanking me, saying wow, it sure works!

I don't care how old you are, if you make some changes in your life you can get on the air from Fiji and Tahiti too. And Nepal. Or even from a king's palace. Or you can work the world from a farm in New Hampshire, where the air is pure and the living about the best in the whole country. Or both. Heck, why not? Or, let's see, what's on TV tonight. Or is it time to call into that old 75m net? Your choice—adventure or status quo.

Enlightening

How many seconds a day on the average do you get out of your ham shack long enough to look up at the sky, close enough to the sun so some of those UVs get into your eyeballs? And without any glasses or windows to filter 'em out?

Now, second question. How many hours a day do you think the people you're descended from spent a day getting UVs into their eyeballs? Before eyeglasses and windows were invented?

Third question. Would it surprise you to learn that getting those UVs into the eyes is vitally important for your health? That a million or so years of living with UVs has developed a dependency on it for your body?

If I can get you to spring the five bucks for my book list, and then go absolutely hog wild to buy a few books and read 'em, you'll learn a whole lot about what your body needs in the way of food, minerals, water, UVs, oxygen, and so on. Needs, and isn't, for the most part, getting.

I've put in a heck of a lot of work finding some books which are exciting and valuable. What I haven't figured out yet is how to get you to read 'em and start changing your life. Sigh.

So now, in order to ignore the above light news so as not to have to change your way of living (and being sick), you're saying to yourself that there goes Wayne exaggerating again. I know you haven't read the Ott or Lieberman books on my recommended list or you'd have written to thank me. Well, maybe I can get you to check out *Sunlight* by Dr. Zane Kime, ISBN 0-9604266-2-5, $12, 315p, World Health, Box 408, Penryn CA 95663. How does sunlight affect cholesterol, blood pressure, and the immune system? No, I'm not selling the book.

Okay, if you don't care enough about your own health to read it, will you educate yourself a little to help your kids live healthier lives?

Autism, Etc.

The *60 Minutes* segment on autism was interesting. You remember *Rainman*. Did you know that before vaccinations autism was almost unknown? As were hyperactivity, dyslexia, and learning disabilities in children?

Did you know that in a double-blind test the polio vaccine caused twice as many cases of polio as it prevented? According to the CDC, 87% of all polio cases between 1973 and 1983 were caused by the vaccine.

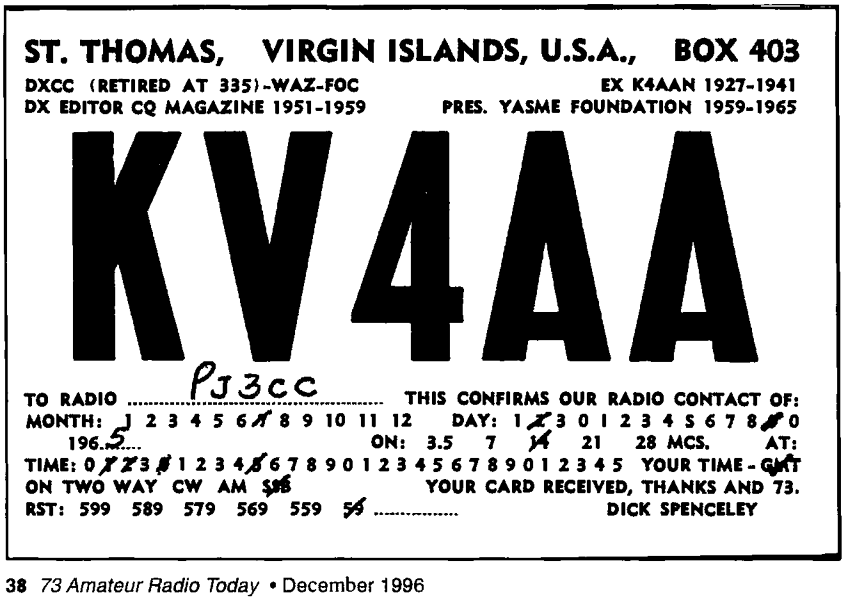
And, oh yes, talking about compulsory poisons, did you know that tests with animals show that they are made much more docile when given fluorides? Like those being added to your water and you're drinking unless you're distilling out the fluorides, chlorine, and other mischief.

Between these compulsory poisons helping to fry our brains, the flowering drug culture and our worst-in-the-developed-world schools, kids' SATs are way down, so they're lowering the scale so it won't look as bad.

If you'll read a couple of the books I recommend you'll learn that sugar and white flour are almost as destructive to your body as they are for your car if you put them in the gas tank. No wonder our police are causing so many problems on their Dunkin Donuts diet.

The Junior Researcher Alchemy Kit

Will it be an entrepreneur or one of the big toy companies that comes out with the first



ST. THOMAS, VIRGIN ISLANDS, U.S.A., BOX 403

DXCC (RETIRED AT 335)-WAZ-FOC EX K4AAN 1927-1941

DX EDITOR CQ MAGAZINE 1951-1959 PRES. YASME FOUNDATION 1959-1965

KV4AA

TO RADIO PJ3CC THIS CONFIRMS OUR RADIO CONTACT OF:

MONTH: 1 2 3 4 5 6 7 8 9 10 11 12 DAY: 1 2 3 0 1 2 3 4 5 6 7 8 9 0

196.5.. ON: 3.5 7 14 21 28 MCS. AT:

TIME: 0 1 2 3 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 6 7 8 9 0 1 2 3 4 5 YOUR TIME - GMT

ON TWO WAY CW AM SSB YOUR CARD RECEIVED, THANKS AND 73.

RST: 599 589 579 569 559 59 DICK SPENCELEY

cold fusion alchemy kit for our budding scientists? (And makes bazillions?)

I was seven when I got a Chem-Craft chemistry set for Christmas. It was beaut! The experiment I remember best was the one using potassium permanganate plus a couple drops of glycerin and then, in about half a minute, the mixture would start bubbling and burst into flame. Wow!

The cold fusion field has developed enough now for a kit to be marketed which would enable experimenters to measure the excess heat generated using different metals and electrolytes. Complete with an interface so a computer could record the data and chart it.

You'd need a small glass cell and a surrounding calorimeter. Hey, if they can sell indoor-outdoor thermometers retail for under $15, that's about all you'd need to measure the inside and outside calorimeter temperatures. I'd supply some powdered metals such as palladium, nickel, and titanium, and the chemicals to make various electrolytes. A wall-wart power supply could supply the current to trigger the reaction. Plus a small motor to stir the electrolyte to distribute the heat evenly. I'll bet the whole kit could be marketed for under $200.

If it were my company I'd be selling refills, plus other kinds of powdered metals such as rubidium, rhodium, and anything else that has a suitable lattice structure for generating excess heat. I'd also start a newsletter for junior researchers, plus include instructions on how to patent your discoveries. This is pioneering territory and the fact is that kids could come up with better and better cold fusion systems.

I'd also look around for a college with one of these newfangled instant mass spectrometers where experimenters could, for a small fee, send samples from their used cells to find out what transmutation products have been generated in the process.

In a recent test using nickel with a lithium sulfate electrolyte in plain water, a cell generated generous amounts of iron, gold, copper, magnesium and chromium ... and, oh yes, heat.

Well, you're probably too busy to be interested in making bazillions anyway, right?

Donor

Perhaps I'm on more mailing lists than you, but I found my mail stuffed with requests for money for political campaigns this last fall. Lordy, the direct mail companies must have made a killing. Those who sent postage paid envelopes got an offer to make a $1,000 donation, but I did ask for some assurance that the candidate would be working for my benefit more than his own, so I included some minor caveats.

Like a campaign promise which would give me a guarantee that I would see some needed changes such as: (1) Term limits for federal judges, plus some guidelines for them, such as a return to the constitution instead of leading the parade for social engineering, as they did with school busing. (2) Get the government and the judges out of religious issues such as school prayer and abortion, which represent still more social engineering. Why are we even arguing about mixing church and state? The constitution was supposed to settle that. (3) The elimination of government confiscation of property through its many agencies. For instance, the property tax effectively makes the owner of property a lessee, not an owner. If you stop paying the tax, you lose your property. If an informant tells the police that you have drugs on your property the police can (and all too often do), without a warrant, break in, plant some drugs, and then confiscate your property. If the IRS decides you owe for taxes they can confiscate your property. I put my life on the line—on the front line—during WWII, but it wasn't for the America I see today. The RICO (organized crime) laws were, as usual, well intentioned. But government agencies have misused them to

Continued on page 49

The Solder Slurper

Build your own desoldering station—cheap!

Dave Evison N6GKC
153 Park Avenue
Palo Alto CA 94306

Whether you're recycling parts mounted on a PC board or repairing some electronic equipment, you want to remove the parts without ruining either the parts or the board. While there are many professional desoldering stations and aids available, most are either expensive or ineffective. Professional desoldering stations are priced from $400 and up, which is more than most of us are willing to pay.

You'll find the Solder Slurper is equal to or better than most commercial units. It uses off-the-shelf parts you can get at any Radio Shack™ and auto parts stores. And it can be built for under $60, even if you buy all new parts. However, if you get a used fuel pump and parts from your junk box, a first-class unit can be put together for just a few dollars.

The Solder Slurper is designed around an automobile electric fuel pump, associated fuel filters, and a Radio Shack desoldering iron. The rubber bulb originally used by the Radio Shack desoldering iron to create a suction for extracting the molten solder is replaced with a hose, filters and the electric fuel pump. The heated tip of the desoldering iron is placed on the joint to be desoldered, the solder is melted, then the foot switch is pushed and the pump sucks the molten solder away from the joint. The first in-line fuel filter captures the molten solder, keeping it out of the pump mechanism. The second in-line fuel filter further protects the pump by removing the desoldering fumes.

While the pump will work with any 12V supply capable of delivering an instantaneous 6A and continuous 2A, I used a gel cell with a trickle charger. Since the in-rush of current is steep when the pump is turned on, many regulated power supplies will blow fuses. If the supply incorporates a crowbar circuit it may also shut down the power supply. The gel cell battery acts as the power source, with excellent low internal resistance, and easily provides the high starting current.

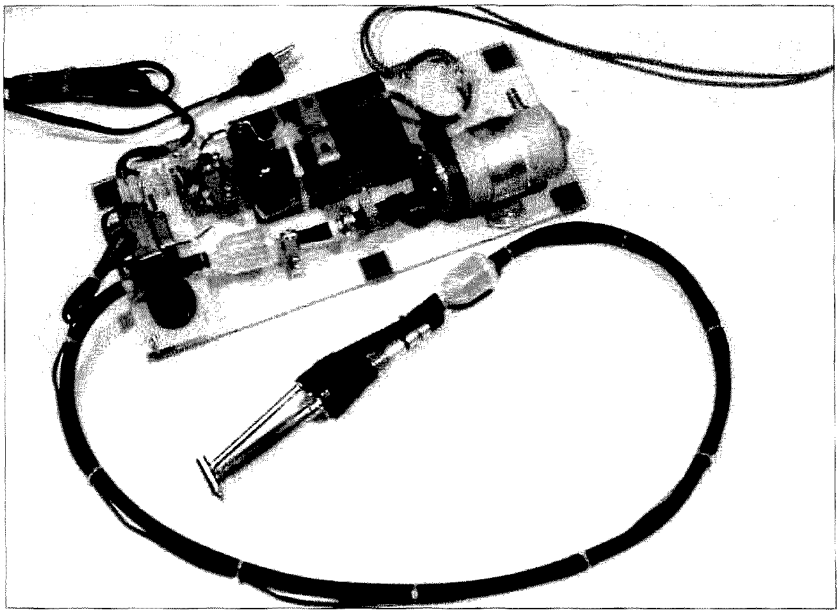


Photo A. *The prototype Solder Slurper.*

The circuit

The charging circuit is designed around a common 12.6V filament transformer and a 15V three-terminal regulator. It is designed to deliver a charging current until the surface charge of the battery equals the charging voltage of the charger (13.4V). The two diodes in the regulator output minimize the discharge of the battery through the charger, should the AC power be removed from the charging unit. The forward drop of these diodes also determines the applied charging voltage to the battery.

Since the Radio Shack desoldering iron is not grounded, a grounding circuit must be added to the soldering iron to protect sensitive parts from an electrostatic discharge. Any one of the three screws fastening the metal iron to the plastic handle will provide an easy way to ground the iron.

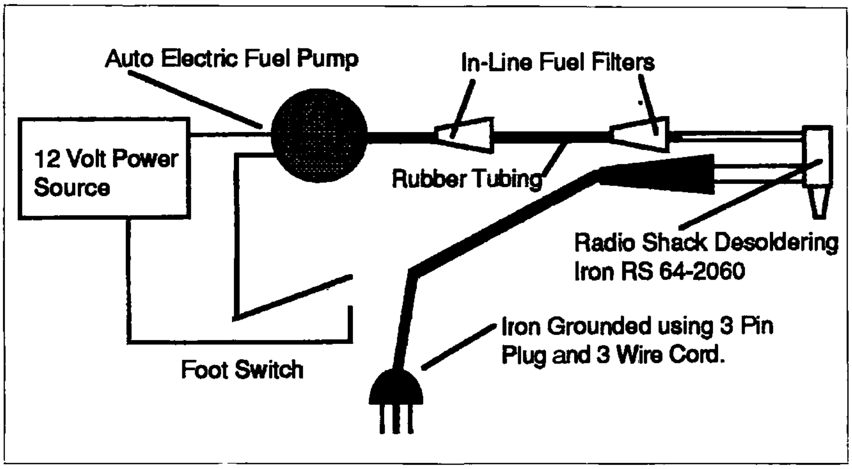


Fig. 1. The system.

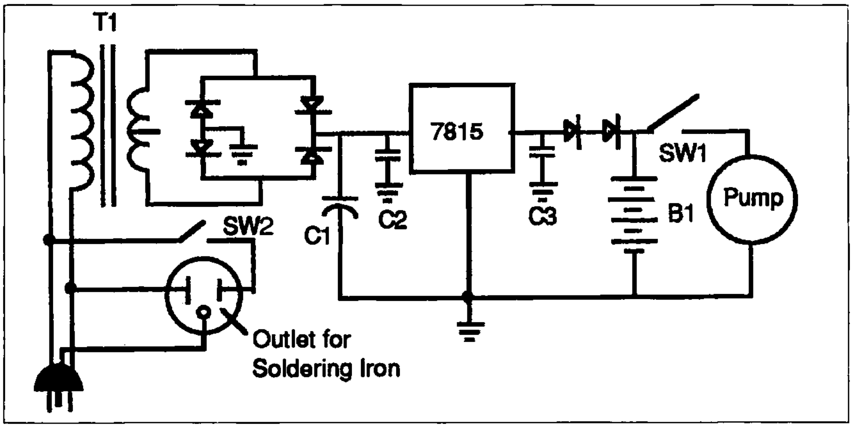


Fig. 2. The gel cell battery trickle charger.

Parts List

Desoldering Iron	Radio Shack # 64-2060
Electric Fuel Pump	Bosch GFP 221 or equivalent
In-Line Fuel Filters	WIX 33011 or equivalent
Interconnecting Hose and Clamps	
AC to DC Power Source	
T1	12.6V @ 1.2A filament transformer (RS 273-1352)
C1	250µF @ 25V
C2, C3	0.1µF @ 50V
7815	3-Terminal Regulator
All Diodes	1N4006
B1	12V Gel Cell Battery, 3Ah or greater
SW1 (Foot Switch)	SPST 10A
SW2	SPST 1A

When connecting the pump, filters, and vacuum hose to the various parts of the unit, make sure you make good vacuum-tight seals. And if you are using a used electric fuel pump, make sure there is no residual fuel or vapor in the pump. Let it run for 10 to 15 seconds to purge the pump prior to extracting solder.

As with any desoldering tool, an accumulation of solder can build up within the hollow desoldering tip and discharge tube of the iron. Heavy build-up can, over time, actually block the discharge tube, so you may have to drill out the blockage.

During heavy usage, the build-up can be minimized by frequently shaking the accumulated molten solder out the hollow tip into an old tin can and by running the pump for a couple of seconds

> ***"A first-class unit can be put together for just a few dollars."***

prior to turning off the iron at the end of the day. Another useful technique to both remove the solder and free the lead being desoldered is to carefully "skate" the tip of the iron on the pad and thereby position the lead in the center of the hole.

Photo A shows the prototype Solder Slurper with the parts mounted on a piece of plastic. While the prototype is ugly, the interconnection of parts is clearly shown. If you put the Slurper in a flashy box, you could sell the units commercially.

The Solder Slurper sure is handy in my small laboratory, and its "Ghost-Buster" look always gets comments.

Columnist Needed

Write a 1250 word monthly column about Mobile, Portable, and Emergency amateur radio operations. Contact Joyce Sawtelle, 73 Amateur Radio Today, 70 Route 202 North, Peterborough NH 03458. Tel. (603) 924-0058.

Audio Filter Alignment Generator

Another piece of test equipment you can build.

J. Frank Brumbaugh KB4ZGC
Box 30 - c/o Defendini
Salinas PR 00751-0030

The vast majority of transmit offsets for CW and SSB have been established at approximately 700 Hz. This is practically an industry standard and is also the offset used in most QRP transceivers, whether they're kits or home-brewed. Therefore, active and passive filters are most often designed to have a center frequency of about 700 Hz and the many circuits found in the ham literature bear this out.

Of course, few if any filters can boast a center frequency of exactly 700 Hz, because electronics is a world of tolerances and percentages, but all such filters will be centered very close to 700 Hz.

There are numerous circuits published for small fixed-frequency audio oscillators, usually Twin-T or phase-shift circuits. But, with tolerances and strays, it takes a lot of "cut-and-try" to get such an oscillator to produce exactly the desired frequency.

"For most hams this will be a junk box project and cost nothing—and it can be constructed in an hour or two."

A much easier way to produce a signal at the exact frequency required to check and adjust an audio filter is to use an audio generator whose output signal is known, accurate and stable. (See "Crystal-Controlled Audio Generator," *73*, November 1995, page 28. Note: There is an error in the schematic. C11 should be connected between the emitter of Q3 and the emitter of Q2.) Although recommended as an accurate and stable generator of signals in the most useful range of 300 to 3,000 Hz, if you only need to trim your filter for a 700 Hz center frequency, this would be overkill.

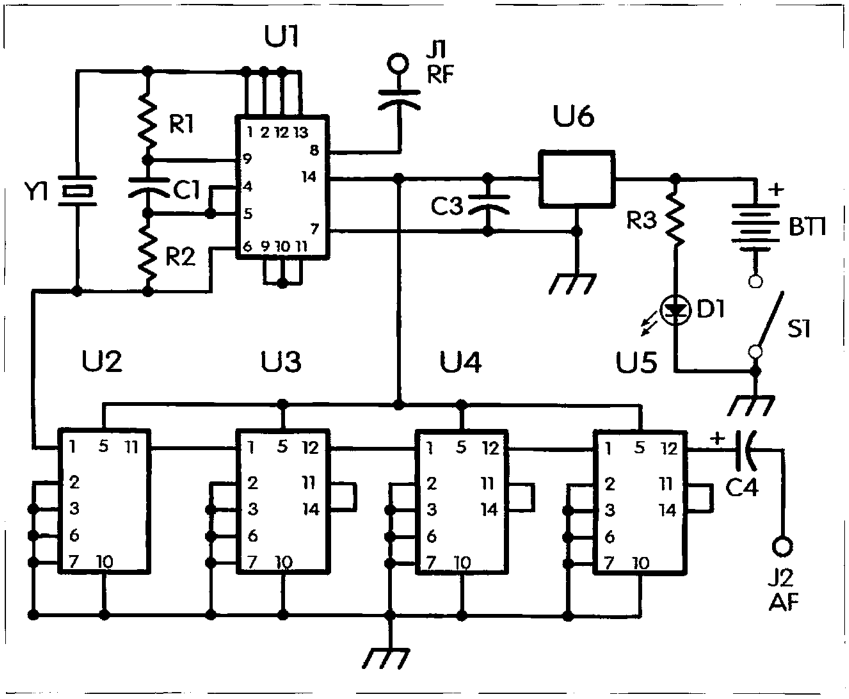


Fig. 1. Schematic diagram for the audio filter alignment generator.

This article describes an even simpler and cheaper audio generator, also crystal-controlled but producing a single frequency of approximately 716 Hz (which is well within normal, even very close tolerance for the usual 700 Hz filter frequency). If this is the only audio frequency you need, you may wish to build this simple project. The output frequency is stable and accurate because it is derived from a crystal oscillator. There will be no drift of the output frequency. The crystal frequency is divided by a factor of 5,000, so the crystal would have to drift 5,000 Hz for the output frequency to vary by 1 Hz. That's *real* stability!

For those hams who need to buy some or all of the few component parts as new "surplus," the cost should not exceed about $5. For most hams this will be a junk box project, and cost nothing—and it can be constructed in an hour or two.

The circuit

In **Fig. 1**, U1 is a 74LS00 quad two-input NAND gate. Two of the gates are connected to form an oscillator controlled by Y1, a common inexpensive color-burst crystal with a *marked* frequency of 3.579545 MHz. The output of the crystal oscillator at pin 6 of U1 is applied to input pin 1 of U2, a 74LS90 configured to divide by five. The output from pin 11 of U2 is applied to input pin 1 of U3, a 74LS90 configured to divide

by 10. The output from pin 12 of U3 is applied to input pin 1 of U4, also a 74LS90 configured to divide by 10. The output from pin 12 of U4 is applied to input pin 1 of U5, a 74LS90 also dividing by 10 to produce the desired output frequency of 716 Hz at pin 12. This 716 Hz frequency is applied to output connector J2 through C4, which blocks the DC voltage at pin 12 from the output connector J2.

The above describes the functioning of the primary 716 Hz audio generator. However, because a color-burst crystal is used, there is a bonus to be derived at no additional cost. The crystal frequency at pins 1 and 2 of U1 is fed through the two unused gates which are connected to form inverters, and is available through DC blocking capacitor C2 at J1, taken from pin 8 of U1. The possible uses of this harmonic-rich signal will be discussed later.

Power is supplied by BT1, a 9 volt alkaline battery, and is controlled by S1, an SPST switch. The 9V source is applied to the input of U6, a 78LO5 voltage regulator which provides a regulated positive 5 volts to all TTL chips in the circuit. C3 bypasses the output terminal of U6 to remove any digital spikes which could affect regulation. The combination of R3 and LED Dl is optional, but it draws only about 3 mA so it is recommended as a reminder to turn the generator off when not in use, to prevent draining the battery.

Construction

The circuit can be built on a piece of perfboard, a general purpose printed circuit board, or "dead-bug" style on a base of any nonconductive material such as plastic or wood. Sockets for the chips aren't necessary, but may be used if you wish. Note: It might be desirable to use sockets for the four 74LS90 chips. I have found a number of these chips, purchased from mail order vendors as "new surplus," which refused to divide. Changing chips in sockets is much easier than unsoldering their pins from a PC board.

An enclosure isn't necessary, but if you do a lot of work with active and passive filters you may wish to build it neatly in a small plastic or metal box, or one made from printed circuit board material.

Operation

Since this is a digital circuit, if the crystal is good and all chips are wired correctly and are in their designated places in the circuit, it will function as soon as power is applied.

If it doesn't work at all, or the output audio frequency is incorrect or unstable, you either have a bad crystal or one with the wrong frequency, one or more bad chips, or something as simple as a wiring error or solder bridge. If you use sockets for the chips, make certain they are in the right sockets *and* are oriented correctly. It will help if you place a dot of white paint on top of each chip at pin 1, and also on the side of the socket at pin 1.

Again, when a simple digital circuit is wired correctly, has all good parts installed correctly, and the proper operating voltage is applied, it will function as designed—period.

Using this instrument

This is a fixed frequency audio generator. Feeding its output into the input of an audio filter while monitoring the amplitude level of the filter output with an oscilloscope or a DMM on a low DC voltage range will allow tweaking the values of pertinent resistors and capacitors for maximum output voltage, resulting in the center frequency of the filter being exactly the same as the generator.

It has a number of other incidental uses as well. It can be used as a sidetone generator. It can be keyed in either the positive or negative power lead as a code practice oscillator, feeding headphones or a small speaker. It can also serve as a signal injector for aligning receiver circuits because the output is rich in harmonics.

Using the bonus frequency

The crystal frequency available at J1, which will be close to but not exactly the marked frequency of 3.579545 MHz, has strong harmonics which fall within or near every ham band from 80 through 10 meters, including the WARC bands. To be useful for calibration checking or as a signal for alignment purposes, these harmonic frequencies must be known accurately.

Measure the frequency at J1, using a frequency counter, then multiply this frequency by each harmonic number from 2 through 8 and note these frequencies for future use.

The signal level at J1 is much too high to feed directly into the antenna connector of a receiver. You can connect a short length of wire to J1 and radiate the signals to your station antenna. Another method is to disconnect the antenna from your receiver and connect a short length of wire to the receiver antenna connector. Drape this wire near the instrument to conduct its signals to the receiver.

Parts List

BT1	9 volt alkaline battery
C1, C2	0.01 µF ceramic disc or monolith
C3	0.1 µF ceramic disc
C4	100 µF electrolytic, 10 WVDC or higher
D1	LED, color optional
J1, J2	Output connectors, your choice
R1, R2	1k 1/4W 5%
R3	2.7k 1/4W 5%
S1	SPST toggle or slide switch
U1	74LS00
U2-U5	74LS90
U6	78LO5
Y1	3.579545 MHz color-burst crystal

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The Art and Challenge of Sending CW

When a QSO is so much more than just "RST, QTH, name and 73."

Bob Shrader W6BNB
11911 Barnett Valley Road
Sebastopol CA 95472

With Hand-Key Night coming up on December 31st it's time to get out the old hand key, rubber-cement it to the tabletop and get ready for some good old-fashioned fun-type CW QSOs. Hand-Key Night is a time when a QSO is much more than just, "RST, QTH, name and 73." It's rag-chewing. It's a time to find out what rigs are used; what bands, what type(s) of work done; when the other op was first licensed, radio backgrounds, latest travels, sports, homes, computers, animals, marital status, kids, greatest accomplishments—everything!

Amateurs know their code sending as "CW," meaning "Continuous Waves." It may surprise some newer hams that this means radio waves that have a constant amplitude (strength), and has nothing to do with how long the waves are being generated. The term developed in the earliest days of radio when code transmissions were made only with spark-type transmitters that produced decaying-strength RF "wave trains." When a spark occurred in a spark transmitter, a high amplitude RF ac was developed, at the quarterwave frequency of the antenna, that rapidly decayed to zero. Each half-cycle of the power-line ac developed a spark and RF wave train of its own. Power line ac with a frequency of 60 Hz used in a spark transmitter produced 120 RF wave trains per second. Originally, all radio communications were made using spark-type telegraphic code signals—there was no such thing as CW or radiotelephone.

When constant amplitude radio wave generators were developed and used for radiotelegraphic code, those emissions were termed CW because they were Continuous-amplitude Waves, not decaying spark-type waves. Today, the term CW has taken on the meaning of any type of radiotelegraphic code used in the MF or HF bands. However, the abbreviation "MCW" indicates an audio-frequency Modulated Continuous-amplitude Wave code signal, which may also be used by hams but only in their VHF, UHF and SHF bands.

It's a challenge

Learning to send CW correctly with any type of mechanical or electronic-aided key does not come easily. Many newer hams have never been advised by qualified CW operators, so may never have been shown how to use a key correctly. Proper finger and hand movements must be learned for whatever type of keying device is used. These correct motions must be practiced regularly to assure proper radio code sending.

Historically, the first sending device was the *hand key*, or *straight key*. The second was the *sideswiper*, *cootie key*, or *double speed key* (meaning a straight key which has two sets of contacts and sends code faster). The third was the *semiautomatic key*, or *bug*. The fourth was the electronically aided *electronic keyer*, often referred to as simply a *keyer*, or improperly as a *paddle* since bugs and cootie keys also have paddles. Keyers are somewhat similar to a bug in operation.

There is also the digital (binary/ASCII) keyboard, or *KB*, used in conjunction with some form of a computer/software system, which is not a key. A KB requires no code or keying ability to make it send CW. Its correlative, a computer with software that will decode received Morse-letter tones, also requires no code operating ability to receive perfectly generated CW letters.

The first three, purely mechanical telegraph keying devices, have been used since the mid-1800s to send "landline" railroad messages, telegrams, and stock exchange information using the American Morse code. Later they were used to send International Morse code for amateur-to-amateur, ship-to-ship, ship-to-shore, and point-to-point communications. How messages were handled is another story. This discussion is about learning to send code properly with a hand key, a bug, a cootie, and a basic keyer.

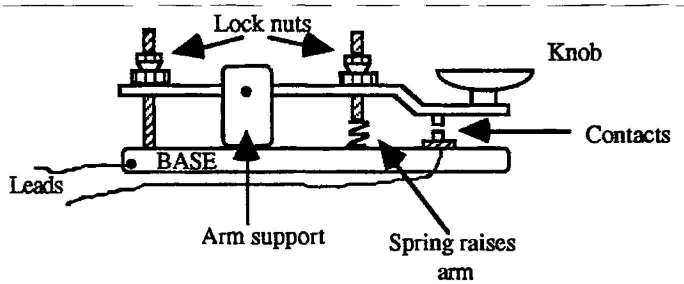

Fig. 1. Essentials of a straight or hand key, side view.

Begin with the basics

Let's start with the oldest and the simplest device, the hand key, which is supposed to be used on Hand-Key Night. **Fig. 1** shows this device in its simplest form. Such a key consists of a metal base, a metal up/down rocking arm, a spring to push the arm upward, and an adjustable stop at the back of the arm to limit how high the front of the arm will rise. It has some kind of an insulating-material knob

on the front of the arm. Most of the metal parts are electrically connected together and are connected to ground potential in radio circuits. Connected to and below the forward part of the arm is a downward-projecting upper contact. Directly below this, spaced perhaps 1/16 to 3/32 of an inch (1.5 to 2 mm), is a lower contact, insulated electrically from the rest of the key. When the knob is pressed downward against the spring's tension, it forces the upper contact to meet the lower, thereby "keying" (turning on) any circuit to which the contacts are connected.

If the knob of a hand key is pushed down only long enough to make a very short-duration contact it results in a "dot" (or short "dit" sound) being sent. If the knob is pushed down and held three times as long, it results in a "dash" (or longer "dah" sound) being sent. (This reasonably accurate 3:1 dash:dot contact ratio is the *first* challenge of sending good code letters.)

I recommend the following methods of operating keys and paddles. They are the result of five years of shipboard radio operating, four years of police radio CW, 26 years teaching International Morse code courses, and 65 years of operating on the ham bands.

One old-fashioned hand key knob has a small vertical bakelite bulb on top of a 2-inch round insulating-material bottom plate. The thumb, first and second fingers grasp the bulb. The dots and dashes are made by pumping the hand down and up (very tiring).

Modern American key knobs are usually round, flat-topped and about one inch in diameter. The method described here is for sending with the more modern key knob. In 1937, my ship, the *SS President Hoover*, was bombed by the Chinese while anchored in the Yangtze River. After sending an *SOS*, I sat and transmitted passengers' messages to the United States for five unbroken hours using such a hand key. Because the path from the *Hoover* to San Francisco (KDMW to KTK) was long, and conditions were poor on 36 meters, bug sending was out. Could you send without stopping for five hours using your present method of operating a hand key?

Here is the way to hold the knob to assure making constant-speed dots, each separated from the next by a space-time equal to the dot contact time, one of the

challenges of good sending: The tip of the first finger should rest on the flat-top knob at about a 12 o'clock position as seen by the operator. The thumb rests against the under part of the knob at about a six o'clock position. It may seem that the knob is being *grasped* by the thumb and first finger. Actually, the touching of both the thumb and the finger is very light. The thumb's only job is to prevent the first finger from wandering off its proper position on the top of the knob. The hand should be relaxed, but held parallel to the desktop, with the palm about two and a half inches above the desktop, the wrist about an inch above it. The arm muscle near the elbow rests on the desk. (A square piece of thin carpet, or other thin padding, under this muscle makes sending a lot more comfortable.)

The other three fingers? They are allowed to hang out in the air to the right of the knob (assuming that the operator is right-handed, although lefties send just as well).

The three fingers in the air have a very important job to do. As the hand is pushed downward from the wrist and is then pushed back up by the spring, the three fingers move down and up, along with the first finger on the knob. These fingers act as an up/down pendulum when sending dots, effectively setting the proper dot-space-dot keying. Dots made this way will produce a code speed of perhaps 15 words per minute (wpm) without any difficulty.

It *appears* that the first finger, or maybe the second, is doing the downward pushing, but actually it is the whole hand. In proper keying, when the key contacts close, your wrist should move upward slightly as the closing of the key contacts stops the downward movement of the hand, raising the wrist. Make *sure* your wrist does this. It is important! If your wrist goes down when your fingers go down you are not relaxed and you are making work out of what should be fun. You are sending with your whole forearm and not just with your hand and fingers. If you send several dots in a row your wrist should rise perhaps a half inch farther above the desktop.

To send faster than about 18 wpm, put both first and second fingers on the knob top. Now only two fingers are acting as a pendulum, allowing a faster up-and-down motion, and faster dots.

How tight should the key's spring be? This is a purely personal decision. Adjust it so that the key's movement feels neither too stiff nor too limp. The contact gap is also a personal preference setting. Try a gap of 1/16 to 3/32 inch (the thickness of three or four QSL cards?). Don't make it too small—you want a good up/down movement of your hand, not a nervous tremor.

(Practice the following: Using your key and a code oscillator or buzzer, send a series of about 100 dots a few times until you get a feeling for the proper pendulum action of your three outer fingers. Keep your hand parallel to the tabletop at all times.)

How about dashes? There's nothing automatic about them; dashes depend entirely on your sense of timing. The pendulum motion of the fingers may help to make dots but not dashes. The wrist should move upward slightly with every dash. Be careful—there is always a tendency to make dashes too short. Concentrate on making your dashes a little longer than you think they should be. With practice the dashes will shorten to a more correct length. If you have a transmitter and an oscilloscope that can show your RF output, connect a dummy antenna to the transmitter and watch the scope. If the horizontal sweep is adjusted to the correct speed you will be able to see the relative lengths of your dashes and spaces. The space between dashes should be one-third the length of a dash. And this should also be equal to both the length of a dot and the space between dots or dashes.

(Practice the following: Make a long series of dashes, trying to make the dashes all the same length and a little more than three times the length of the spaces between them. Yes, it's a challenge.)

One important point: Do not allow your finger to rise off the surface of the knob while sending. You should never be *tapping* the key. Push the knob down and let the spring return your finger upward without your finger losing contact with the knob top.

A good preliminary practice for making letters and numbers is to practice making a string of perhaps 50 dahdidahs—then a string of 50 didahdits—then 50 didahdahdits—then 50 dahdididahs—then 50 dididahdahdidits—and so on, until you are making strings that include five dots and then strings with five dashes in them.

Normally a hand key can be used for speeds up to about 18 wpm (to perhaps 23 wpm with two fingers on the knob.) If you want to go faster than about 20 wpm with purely mechanical keys, you might use the old-time sideswiper, cootie, or double speed key, shown in **Fig. 2**. It consists of a horizontally movable spring-steel arm that returns the arm to a central resting position when not pushed to either side. The steel spring is anchored at its far end to a post on the metal base that is normally at ground potential. The length of the arm-spring determines the stiffness of the side-to-side, or lateral, movement. A bakelite paddle, about an inch and a half long and three-quarters of an inch high, is attached to the arm's near end. To both right and left of the arm are adjustable screw contacts that are insulated from the base. The contacts are adjusted so that the arm must move about 1/16 to 3/32 of an inch from its resting position to strike either the right or the left contact. A quick push to the right will produce a dot. Hold it a little and the result is a dash. The same is true pushing the paddle over to the left contact. (It is actually a double horizontally-operated hand key, using both finger and thumb to make dots and dashes.)

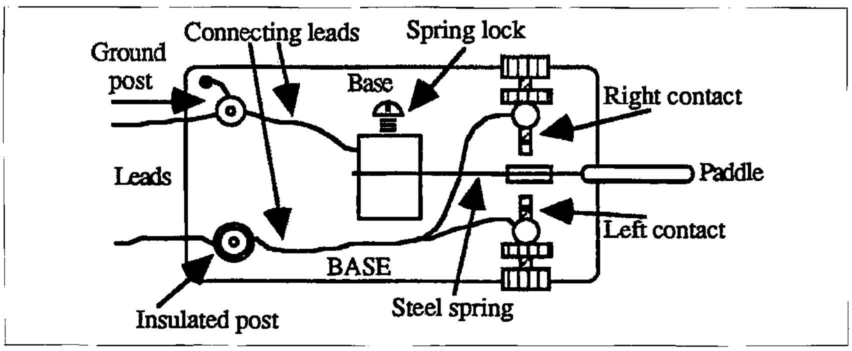

Fig. 2. Essentials of a sideswiper, double speed, or cootie key, top view. (If the right contact post is disconnected from the left, this could be the paddle of a simple electronic keyer.)

With a cootie key, if you move your finger and thumb back and forth rapidly several times you produce a series of dots. If you hold the contacts longer, you produce a series of dashes. A quick contact to the left followed by a longer contact to the right produces an "A." Similarly, a quick contact to the right followed by a longer contact to the left also produces an "A." (It takes a lot of practice to make these monsters put out good Morse code!) You have to be able to send both dots and dashes with both thumb and first finger. (Should a cootie key qualify for Hand-Key Night?) To learn to send with a cootie use the same didah practice suggestions above.

The cootie key represents the greatest challenge of any of the mechanical keys. Sideswipers were used in early RR and radio days because they were cheap and easy to construct. They are both easier to operate and will send faster than a hand key does, but relatively few operators use cootie keys today. You can usually recognize cootie operators by the "swing" (slight variations of dot and dash lengths) that becomes unique to each operator. Swing gives a special character to sending, setting the operator apart from the machine-like perfectly-spaced sending of electronically aided keyers and keyboards. (Unfortunately, commercially made sideswipers are no longer available but they're easy to put together from parts out of most junk boxes.)

The best hand position for the sideswiper and other side-to-side keys is to rest the right edge of the hand and the first knuckle of the little finger on the tabletop, rotating the upper part of the hand as well as pushing the thumb and first finger from side to side to make the dots and dashes. (An anchored hand position was a necessity for operators aboard rolling and pitching ships!) Don't be afraid to hit the paddle reasonably hard. This makes good solid letters.

The cootie is a good mobile CW key. A sideswiper can be used for code speeds in excess of 23 wpm without much difficulty.

Unlike using a hand key, neither the first finger nor the thumb should rest with any significant pressure on any side-to-side operated paddles, but they must never be far from it. When the thumb is pushing, the finger will be off the paddle, and vice versa. If paddle-type keys are not anchored, they will move when the paddle is pushed. To prevent this, coat the feet of such keys with rubber cement to secure them to the tabletop. Cemented down, they will take quite a beating without coming loose, and rubber cement is easily removable, leaving no residue.

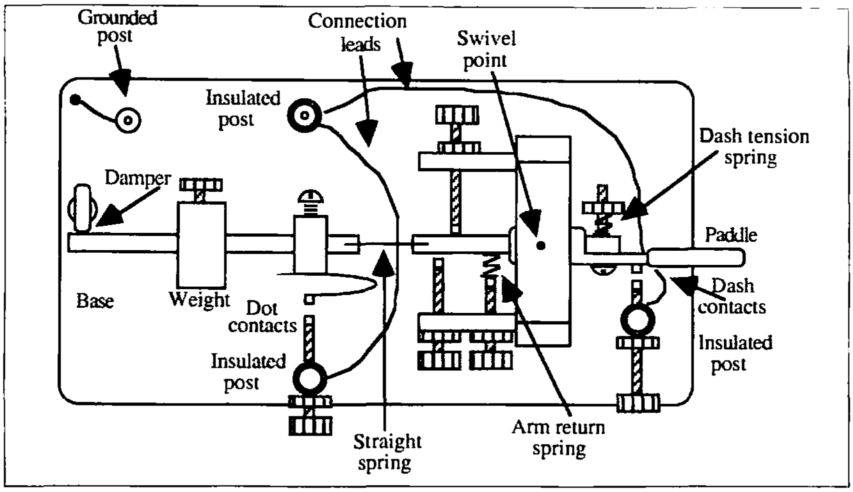

Fig. 3. Essentials of a semiautomatic key, or bug, top view.

The easiest mechanical key to use for speeds up to 40 wpm by good operators is the semiautomatic key, or bug, shown in **Fig. 3**. (It is shown with a simple, single paddle, although more complex paddles are also used.) The bug is a little like a cootie key. However, a bug has a straight spring at the end of its first horizontal-moving arm, which in turn is attached to a second, weight-carrying rod. This last rod can be made to vibrate side to side in pendulum fashion. Each time its U-shaped dot-contact spring hits the dot contact on the insulated post at the left, its vibration makes dots as long as the paddle is held to the right by the thumb. A quick push produces one dot; a slightly longer push produces two dots—a still longer push produces three dots, and so on.

Pushing the bug paddle to the left with the first finger connects the arm to a contact on a second insulated post. This sideways finger push makes dashes essentially the same as a downward-pushed knob makes dashes with the hand key. (When bug operators want to send code slowly they may use the dash paddle as a side-operated hand key.) The bug only makes dots automatically—it's up to the operator to make the dashes properly, in both number and length. The contacts on the dot and the dash posts are connected together electrically and are brought out at the insulated output binding post. The other output binding post is connected to the metal base. As with the cootie key, bugs should be whacked fairly hard to make sure that good solid dots and dash contacts are made.

Bug adjustments are more complex than those of hand and cootie keys:

•1. Whenever the paddle is released, the arm-stop screw at mid-right must be set to just stop the swing of the vibrating arm against the damper mounted at the far back edge of the bug. With the damping position fixed, the locknut on the arm-stop screw is tightened so the adjustment cannot change.

•2. Adjust the dash paddle swing at front left for a spacing of 1/16 to 3/32 of an inch and tighten the locknut.

•3. The dot-arm stop screw at mid-left is set to about 1/16-inch spacing and its locknut is tightened.

•4. The mid-left dot-arm spiral spring is tightened or loosened to a comfortable paddle feel.

•5. Move the weight (or weights) on the vibrating arm to the far end of the arm and tighten. This produces the slowest pendulum movement and therefore the lowest speed dots.

•6. Connect the bug across an analog ohmmeter. Push your thumb solidly against the paddle and watch the

ohmmeter indicator needle. Adjust the U-shaped spring's dot contacts until the needle vibrates at mid-scale, indicating the dot and space times are equal. Theoretically, this is the correct setting, but slightly longer dots than spaces are easier for distant stations to read. Therefore, adjust the dot contact so the meter needle vibrates at a point a little to the right of vertical or mid-scale. (When properly adjusted, the bug should make about 10 good sounding dots before it goes into a solid contact.) The dot contact can also be set by watching a scope while the transmitter is keyed into a dummy load.

With bugs, the tendency is to set the dots at too rapid a rate. Listen to your fastest *comfortable* hand-key dot speed, and adjust the bug dots to just a little faster than that. When you have perfected your bug sending at about 18 wpm (when you can send out of a book for one minute at 18 wpm without making a single mistake), then you can increase the dot speed for faster sending. Practice operating a bug using the same didahdidah suggestions made above for the hand key.

Remember a good old Code Sending Law: "It is unlikely that you will send well at speeds faster than you can receive well." Don't try to impress other operators by using high-speed dots—you can't kid them for long about your CW ability. On the other hand, if you can obviously receive and send faster than the other operator, slow down to a speed he or she can handle or you'll be wasting your time sending information not being copied. Remember, many slower operators can produce interesting, worthwhile QSOs.

A good operator can set his bug dots for about 30 wpm and never change them. If the receiving operator can only receive 18 wpm, the bug operator can put greater space between letters and words so that the average speed is only 18 wpm. This provides good practice for the other operator to copy more rapidly made letters. If the sending operator never has to change the speed, more error-free sending is possible.

Bugs may generate dots automatically, but it is still up to the operator to make the dashes three times the length of the dots. A newer post-WWII development is the fully automatic electronic keyer. Through the operation of its internal electronic circuits, when the thumb is pushed against the bug-like paddle, a continuous string of perfect dots is produced. Pushing the first finger against the paddle makes a continuous string of perfectly made dashes exactly three times the length of the dots.

Although dots and dashes can be made more perfectly with keyers, inter-letter and inter-word spacings are still important for readability. Using a dot time as the unit of measurement, inter-letter spacing should be three units long, inter-word spacing five units long, and inter-sentence spacing seven units. There is still a challenge to send good Morse code even with keyers.

If you have a keyer and would like to try operating it as a sideswiper, many keyer paddle assemblies can be clip-lead connected so that they can make a hand-key type contact when pushed either to right or left. The paddle can then be plugged into the hand-key jack and used as a cootie key (if your keyer is built into your transmitter, or is a self-contained operating unit, this will probably not be possible).

During a QSO, if you have to stop to think while sending, try to do it between words—don't do it between dots and dashes in letters.

Never break up a letter by leaving excessive space between dots and dashes in it somewhere. If you happen to do this, make the error sign (eight dots) and go back and resend the whole word in which you made the error. Try to make the dots/dashes of all letters together to form one tied-together sound, leaving a noticeably longer space between one letter and the next. Similarly, each word should be an unbroken unit of sound.

Use abbreviations sparingly—rarely will they save much time. More likely, the confusion developed by your not sending complete words will puzzle the other operator. When a letter in a word is interfered with by static, it is far easier to guess what the missed letter of a spelled-out word might be.

To make *perfect* dots, dashes, letters and spaces there is the computer keyboard program. When you type "CQ CQ" you transmit a perfect "CQ CQ" with perfect inter-letter spacing of three dots, and when the space bar is struck you get a perfect five-dot spacing if you are typing properly. To become a good keyboard operator you should probably attend a secretarial school to learn touch typing so that you can keep ahead of the speed you choose to send in real time on the air. If you can't type properly, if you have to hunt and peck, you will leave many spaces in words where spaces don't belong. High speed Morse code in which inter-letter and inter-word spacing is incorrect, or words are misspelled, is very discouraging to good receiving operators. Keyboards are great—if you know how to use them properly, but they don't provide much challenge.

Because keyboards do provide perfect sending of plain language material typed into their memories or buffers, they are used to provide perfect code speed practice to over 100 wpm! Without a source of perfect high speed transmissions there was no such practice available, but today, high speed copying ability can be checked easily by having an amateur listen for a few minutes to a high-speed plain-language CW transmission, and then summarize what was transmitted. High speeds around 100 wpm are too fast for ordinary people to copy onto paper. For high-speed communicating, CW keyboards only substitute the Morse code for the Baudot code of radioteletype, AMTOR, or the ASCII code, but the AFSK used with RTTY, etc. is considerably superior to electronic CW signaling if there is external noise present.

With the proper software program and electronic equipment coupled to a computer it is possible to display received Morse code words and sentences on a monitor screen (such programs will copy Morse code poorly if it is not sent perfectly).

The old-time American Morse code that used to be heard on the ham bands at times used different spacings in some of its characters and different length dashes. These could be made with hand keys, bugs and sideswipers, but not by keyers or by keyboards using the usual computer CW software. Too bad. It has caused the demise of that early-day, historical telegraph code.

If you like challenges, see if you can learn to send Morse code well with all three non-electronic keys! Let's all help keep ham radio's original means of communicating on the air—and try to interest *others* in participating more in the fun of good radio code operating. See you on Hand-Key Night this December 31st!

Continued from page 39

confiscate property. (4) The "war on drugs" has been a very expensive war and the government has lost it. This has been an enormous government fiasco. Get the government out of this mess and let the capitalist marketplace take over. (5) Get the government out of supporting prices. Let the market control prices and stop subsidies for tobacco, farmers, sugar, power, and so on. (6) The most expensive war in the history of our country has been the "war on poverty." The government, both state and federal, should get completely out of this failed social engineering project and let the market handle it. A number of people in government seem not to have noticed that socialism has failed in every country where it has been tried. They should be forced to visit some countries where it has been implemented, such as Russia, Yugoslavia, Sweden, China, Sudan, etc. I have. (7) Socialism has failed us in our school system. The law forcing kids to go to school is tantamount to slavery. With government-run schools costing two and three times as much to run as private schools, it is time for the government to get out of messing up the education business and let competitive for-profit forces provide this service. Our country had a much higher literacy rate before public schools were forced on us. (8) It is federal and state regulations which have made such an incredible mess of our so-called health care system, making it one of the most expensive in the world, yet providing us with third-world grade health care. Get the government out of this social engineering and let the market control our medical industry. (9) With lobbyists in every state capital and Washington, I would like to see an enforced law prohibiting any representative of the people from publicly discussing or voting on any matter in which they have a pecuniary (conflict) interest. Thus, if they accept money or favors from any person or group, they would be prohibited from being a paid agent of that person or group toward initiating or changing the laws possibly affecting that person or group. (10) Illegal immigration is against the law. Either change the laws or enforce them. Until the government social engineering projects providing free food, housing, money, education, and health care for illegal immigrants are ended our country will continue to be a powerful magnet for illegal immigrants, with the rest of us paying the bill or being put in prison for non-payment of ever-escalating taxes. (11) There's more, like our expensive postal monopoly, but that will give you an idea of the platform I would be delighted to support with my money, just as I believed I was supporting these concepts when I put my life on the line in WWII.

Scientific Evidence

Do you personally have to see something to believe it? Supposing the same event is reported by a number of people who have had no way to get together to concoct the story? Scientists have a problem believing in anything they can't reproduce on demand with 100% reliability, yet there is a wide variety of things going on which don't fit in with those restrictions. And, of course, if we get into religion or politics, we run into many areas of strongly-held beliefs that have no scientific support.

While I've always had an interest in the occult, UFOs, and other anomalies, I've been annoyed by the closed-mindedness of many people who reject the experiences of others. When something unusual happens, my instinct is to investigate it and try to understand what's going on, not to make every effort to reject or ignore it.

Scientists tend to sweep the unexplainable under the rug as "anomalies." For them that's enough of an explanation, and never mind trying to understand the anomaly or reproduce it. Doctors have the same mind-set, sweeping aside sudden cures for fatal illnesses as "spontaneous" cures. Thus, instead of trying to find out what in the heck brought about the "spontaneous" cure so it could be used to help others, they close their mental doors.

For thousands of years people have been reporting near-death experiences (NDEs). There's a magnificent book by Dr. Crookall, *The Supreme Adventure* (1961), which examines hundreds of NDE reports and shows how remarkably consistent they are. He then takes the next step and examines hundreds of reports from the "next world" as received through mediums. These, too, are consistent with the NDE reports. It's almost enough to make a person think.

I've read three recent books you might want to look for. There's Dannion Brinkley's *Saved By The Light* (1995; 204p), where he was struck by lightning and had quite an NDE. It's worth the $6. Unlike most other visitors to "heaven," Dannion claims to have been given some glimpses into the future. If you've been keeping up with the latest in technology you'll find his piece on the coming development of DNA-type computer systems most prescient for a 1975 NDE experience.

Then there's Mally Cox-Chapman's *The Case For Heaven* (Putnam 1995; 203p; $30). She goes into detail about her own experience, and then tells the stories of dozens of more people she's interviewed who've had similar experiences. Having gradually become an old man, and thus perhaps a little more concerned with death, these "light" books are of increasing interest to me.

There's Betty Eadie's *Embraced By The Light* (1994; $6; 145p). You should be able to whip through it in less than an hour. She puts more of a religious interpretation on heaven than most others who've been through the experience, but her story is quite similar to all the others in most respects.

Another NDE resource is Cherie Sutherland's *Reborn In The Light* (1995; $6; 303p). Like the others, she reports on a number of people she's interviewed. Their stories are remarkably similar. There is the pattern after the NDE of no longer fearing death, but

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Join the North Pole Network

Smiles are virtually guaranteed when hospitalized kids talk with St. Nick.

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We discovered the joys of ham radio Santa visits 20 years ago when April was a department head at a large hospital. One December day, she heard that a group from a prominent Los Angeles area ham club would be coming that evening to let the Pediatric unit children talk to Santa. She phoned the club's contact person and volunteered to serve as a hospital liaison.

Only one ham from that club (Jack Lemaster WB6ECB) showed up. Rather than disappoint the kids, the three of us put Santa on the air. That hooked us; we've done it every year since. We have lots of help from the hospitals and from members of the Hospital Disaster Support Communications System (HDSCS), an Amateur Radio Emergency Service unit here in Orange County. Even though Jack has moved out of the area, he occasionally comes back just for this activity.

Photo A. *"Santa knows me!" This moment of surprise is the best part of every QSO with St. Nick. April Moell WA6OPS holds the mike.*

Personalize it

Everyone loves to be called by name. What could be a greater thrill to a youngster at Christmas time than to have Santa himself recognize you? That's exactly what happens when HDSCS visits Children's Hospital in December (**Photo A**). After the roving operator is introduced to a patient, the radio call is made: "Calling the North Pole! This is WA6OPS in Orange County, California. Santa, we're in room 217 of Children's Hospital by Bed 2. Do you know the little girl here?"

For a few seconds, her receiver emits the sound of reindeer, sleigh bells, the cold north wind and then, "Ho, Ho, Ho! Merry Christmas, Jennifer! How is Chips, your new little puppy?"

Jennifer is an instant believer. Santa has established his credentials in a big way, thanks to earlier sleuthing by hospital elves. Over the past week the nurses and therapists quietly collected information about every patient to be visited. It doesn't take a lot—just enough to assure the youngster that Santa is for real.

Even the most skeptical kids are hooked by a well-prepared Santa. In one four-bed room, patient #1, an eight-year-old boy, feigned great disinterest as we came in, so we talked first to the others. He perked up noticeably as Santa greeted patient #2 with his name and some personal information. As Santa next gave a similar hello to patient #3, patient #1 bounced up and down in his bed and shouted to patient #4, "That's the Man! That's the REAL one!" He could hardly wait for his own turn.

Of course, information gathering must be done inconspicuously by the staff. Usually there is useful data in the medical chart and their own notes. Santa can make use of the child's name, age, nickname, grade in school, family members, pets, a favorite toy or food, special interests, etc. Only a few of these items are necessary for any particular child.

"Patient #1 bounced up and down in his bed and shouted, 'That's the Man! That's the REAL one!'"

If it would be helpful to have words of encouragement from Santa and Mrs. Claus such as, "Work hard in your physical therapy," let Santa know in advance. Of course, Santa should never promise to bring specific gifts, but if it is known that a certain item is planned for a child, it might be appropriate for Santa to comment that "The elves are working on it in the workshop." Elves should be sure to let Santa know of any sensitive matters. For instance, you don't want him to mention Dad when a Dad doesn't exist.

Most of our elf work is done before the hams arrive, but it's also good for Santa to have last-minute intelligence to fill in the gaps. A "spy elf" goes along with our ham entourage from room to room. She quietly observes what the kids are wearing, what decorations are in the room, what they are doing, and what family members are

present. Then she goes outside the room and surreptitiously clues another elf at Santa's communications center,, who relays the information to Santa (**Photo B**).

The staff at Children's Hospital loves elf work and looks forward to the hams' coming. Sometimes they even sneak in a little "behavior modification." When Santa greeted one little boy by name and asked if he was still sucking his thumb, the thumb shot out of his mouth and stayed out for the remainder of the visit.

Photo B. *In a secret location within the hospital, Santa's helpers handle the North Pole linking and elf work. Left to right are Tom Gaccione WB2LRH, an unnamed hospital volunteer, "Woody" Woodward KJ6LE and Ken Simpson N6IDE.*

Gifts for the kids

We have heard of groups that give out candy canes after each Santa QSO, but they risk protests from the nursing staff. Sweets may violate dietary restrictions and can be an infection hazard for patients in isolation. Small toys or stuffed animals are better. Of course for infants and toddlers these items must be "kid-proof," with no parts that can be pulled off and ingested.

For the past 12 years, we have given out two-inch round buttons that read, "I talked to Santa on Amateur Radio." Everyone loves them, including parents and nurses, who frequently ask if they can have one, too. (Sure, if they talk to Santa!)

These buttons are great publicity for our hobby. The patient and his entire family are reminded that amateur radio is the service that brought them St. Nick. In the early years, we heard ourselves referred to as "the CB group that talks to Santa Claus," despite our educational efforts. Since we started passing out the buttons, the confusion has stopped and they have become collectors' items.

Such buttons are easy to obtain and are popular with youth sports leagues. Your club may have a member with a button-making machine; the cost of materials is not high. Another alternative would be an adhesive sticker, about the size of a name tag, with the same words.

A new name

Old-timers say that this activity has been going on in Southern California for 40 years, traditionally called "Operation Santa Claus." Tradition is nice, but we stopped using that name long ago. It was causing confusion to hams and non-hams alike. At least one of the military services and several other organizations here have used this same name for their holiday charity efforts for many years. When we would mention our "Operation Santa Claus" activities, listeners immediately assumed we went around collecting toys.

Today we use a much more descriptive title: The "North Pole Network." In news releases, we call it the "North Pole Amateur Radio Network" for further clarity. If you like this name, we encourage your group to adopt it.

We nixed the boob tube

After our first year of Santa hospital QSOs, we got the bright idea of using 430 MHz ham television (ATV) to let the kids see Santa as they talked to him. The next year Santa transmitted on that band and we lugged a cart with a TV set, ATV receiver and yagi antenna from room to room. Multipath propagation of signals through the hospital corridors resulted in noisy ghosting video. The kids weren't impressed.

For the next several years, Santa was visible in each kid's room via the hospitals' closed-circuit TV systems. Video and audio quality was much better, but Santa had to be on camera for almost three hours as the radio operators went room to room. Besides being hard on Santa, who had to "mug" for the camera in between QSOs, it meant we could not covertly give Santa last-minute elf information, and we found ourselves putting on a full-blown TV production each year.

Nowadays, we use radio only. Santa likes it better, because he can concentrate on talking to the patients and not worry about his appearance. The kids are just as happy, because their imaginations can create a better Santa image than we could ever provide.

To ensure good radio coverage of each room, we put Santa in an out-of-the-way office within the hospital. The link is on an obscure simplex frequency, rather than a repeater. This has eliminated inadvertent and malicious interference, which could ruin the event and be an embarrassment to both hams and hospital staff.

We have discovered that 223 and 440 MHz are much better for Santa communications than 2 meters, for two reasons. First, UHF signals propagate much better than VHF within the halls and floors of hospitals. Second, computerized hospital equipment often radiates "birdies" that cause loss of receiver sensitivity at 144 MHz, but they are usually not present on higher bands.

Include all ages

Everyone wants to be nice to kids at Christmas. North Pole Network is just one of the many events at Children's Hospital of Orange County every December. There are carolers, clowns, firemen, and so on. But who brings holiday joy to older hospital patients?

Christmas time is an emotional roller coaster for a patient with a physical disability. The joy of the season can be offset by the miseries of infirmity and loneliness. You might not think that a talk with Santa on radio would mean a lot to a teenager, a middle-ager, or a senior citizen. After all, the patient is old enough to realize that Santa isn't really 3,800 miles to the north. But for many, this annual visit is a real uplift.

The patient is cheered by the friendliness and by the fact that a group of strangers thought enough of him or her to put on a special program. All the wonderful

memories of Christmases past are rekindled. As one elderly gentleman exclaimed into the mike, "Santy, it's good to talk to you again. You and I go 'way back!"

Getting in the door

If someone in your club is or knows an employee of your local hospital, have that person find out whom to contact to arrange for a North Pole Network visit. At large children's hospitals, ask for Recreation Therapy or Child Development staff to assist.

At most local community hospitals, you will have the best results by starting with the public relations department. These employees often arrange visits from local volunteer groups such as Christmas carolers and firefighters. Keep in mind that many facilities have only a few children in the Pediatrics unit. As Christmas approaches, most will be sent home if possible and only the sickest will remain hospitalized. Consider visiting both adults and children at these locations.

Hospitals with rehabilitation centers usually have Recreation Therapists who arrange special activities for patients. If there is no Recreational Therapy department, contact the Occupational Therapy department. Convalescent or skilled nursing facilities have an Activities Director or Recreation Leader. These people are always looking for activities for their patients and if you present North Pole Network appropriately, they will be delighted to plan for your coming.

"One elderly gentleman exclaimed, 'Santy, it's good to talk to you again. You and I go 'way back!'"

Most hospital staff have no or little familiarity with amateur radio. It is important to meet with staff beforehand to acquaint them with what you want to do. Show them this article and tell them about your previous North Pole Network experiences, if any. Demonstrate the equipment you plan to bring into the hospital.

Be prepared for some hesitancy. Most hospitals are concerned about interference with their medical equipment. Assure them that ham hand-helds are not like cell phones (usually banned in hospitals). Experience has shown that the potential for interference is very low. But if they do not want you to transmit from rooms with respiratory equipment or specialized monitors, comply with their requests without argument. Always use the lowest transmit power possible. Use a speaker-mike on your hand-held and sterilize it with alcohol as directed by the nurses when you visit patients in isolation rooms.

As North Pole Network veterans, we know what a wonderful feeling this program can give to hams, patients, and the hospital staff. We hope your club will join the fun this year.

April Moell WA6OPS is head of the Hospital Disaster Support Communications System (http://members.aol.com/emcom4hosp on the Web). Her E-mail address is emcom4hosp@aol.com. Joe Moell KØOV is *73*'s "Homing In" columnist. No, he doesn't play the part of Santa.

Number 53 on your Feedback card

CARR'S CORNER

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One of the nice things about ham operators is that they have a lot of technical interests, some of which are related to ham radio, and others which aren't so related. I've come across a series of products that will meet both classes: the Speake & Co. FGM-x series of magnetic sensors. These sensors are distributed in the United States by Fat Quarters Software [24774 Shoshonee Drive, Murrieta, CA 92562; 909-698-7950 (voice) and 909-698-7913 (FAX)].

There are several different sensors in the series, and these are designated models FGM-1, FGM-2 and FGM-3. **Photo A** shows the Speake FGM-3 magnetic field sensor. It is 60 mm long by 15 mm diameter (2.36" x 0.59"). One of the other sensors in the series is a bit smaller.

The FGM-3, which I have a sample of, is a three-lead device. A set of three wire leads provides connections to make the sensor operational: red +5 VDC; black 0 volts (ground); white output signal (TTL compatible).

The output signal is a frequency that is proportional to the applied magnetic field. The magnetic detection rating of the device is ±0.5 Oersted (±50 µTesla). This range is said to cover the range of the Earth's magnetic field.

Multiple FGM-x sensors can be used to provide such things as compass orientation, three-dimensional orientation measurement systems, and three-dimensional gimballed devices such as virtual reality helmet display devices. It can also be used to provide magnetometry (including Earth's field magnetometry), ferrous metal detectors, wreck finders (diving enthusiasts take note!), conveyer belt sensors or counters, and a host of other applications where a small change in magnetic field is the important transduction event.

One way that hams can use the FGM-x series of sensors is as a magnetometer used to correlate fluctuations in the Earth's magnetic field to propagation changes. Some hams use an array of instruments to study radio propagation. I've seen (or heard of) the use of Geiger counters, 15 to 33 kHz VLF receivers, HF receivers permanently tuned to a station like WWV, and a species of home-brew magnetometer called the "jam jar magnetometer." The Speake/Fat Quarters FGM-x series of sensors can be used to replace the "jam jar." It might be interesting to see what can be learned by having a radiation detector, VLF radio detector, WWV receiver and FGM-x magnetometer collecting data in parallel. With the modern, low-cost data acquisition capabilities of computers, it should be easy to collect such data round-the-clock.

Also, I've noted that the 8088-based "XT-class" MS-DOS computers, which don't run Windows©, can be used for such monitoring with the simple addition of one of those multichannel A/D converters that operate from the parallel printer port of the computer. Those XT-class computers can be obtained in a price range from free to about $50, with hard drives in the 20 mbyte to 100 mbyte range. With such a low cost data acquisition platform, one need not worry about a distant lightning burst generating a line transient that snuffs out the computer. If it does, then so what? Buy another $50 wonder machine and go again.

The FGM-series device output is a +5 volt (TTL) pulse whose period is directly proportional to the applied magnetic field strength. This relationship makes the frequency of the output signal directly proportional to the magnetic field strength. The period varies typically from 8.5 µS to 25 µS, or a frequency of 120 kHz to 50 kHz. For the FGM-3 the linearity is about 5.5 percent over the ±0.5 Oersted range. Speake and Fat Quarters literature claims that these sensors are superior to Hall effect devices because they have a much better temperature coefficient.

In addition to the FGM-3, there are also the FGM-1 and FGM-2 sensors (which should be available soon in the USA). The FGM-1 is a smaller version of the FGM-3, with a range of ±0.7 Oersted (±70 µTesla). It is basically the three-terminal FGM-3 device, but in smaller form and with a fourth lead wire to permit feedback for linearity improvement and zeroing of the output frequency under external control.

The FGM-2 is an orthogonal sensor that has two FGM-1 devices on a circular platform at right angles to one another. This orthogonal arrangement permits easier implementation of orientation measurement, compass and other applications. One possible application that intrigues me is as an antenna orientation sensor. Also, it occurs to me that the orthogonal sensor might be used to cancel out the effects of local magnetic sources other than the desired one, such as a guard antenna on an array might do.

The price of the FGM-3 is $36.50 as of this writing. There is also a high sensitivity, limited range device called the FGM-3h for $38.75. Shipping and handling is $2 for the first item, and $1 each for additional item in the same package. The price of the FGM-1 is $36.50, and FGM-2 is $54.75. Keep in mind that these are imported sensors, so the vagaries of the currency exchange rate could affect the actual price. If you order now, I suspect that the prices quoted in their literature (and reproduced above) are valid, but if you wait a while, until they have to restock, then you will risk an increase in price as the dollar and pound sterling move relative to each other.

Special IC devices for the FGM-3

Speake also offers a series of special purpose integrated circuits that interface the FGM-x series of sensors to other things. One that

Photo A. The Speake FGM-3 magnetic field sensor.

I've had some experience with is the SLC-006 device. It can be used with a DAC to produce an analog voltage output, as well as alone if you want an eight-bit binary digital output.

The other IC devices intended for use with FGM-series sensors are the SCL001 magnetic field nulling system and gaussmeter, the SCL007 high sensitivity gradiometer and magnetic anomaly detector, and the SCL002 vehicle detector. Fat Quarters has developed a printed circuit board for the SCL-006 device and can supply it in either kit form or built. Give 'em a try.

High school science teachers might want to keep the FGM-x series of sensors in mind for classroom demonstrations, and for their students' science fair projects.

Note: The applications literature for these devices is available from Fat Quarters Software (see address earlier). You will find that the circuits use the European method of specifying components. For example, a 4.7 µF capacitor is listed as "4µ7"; a 0.47 µF is "µ47"; a 4.7k ohm resistor as "4k7"; and so forth. They also use the units nanofarads (nF), which may be unfamiliar to North American readers. One nanofarad is 10^{-3} microfarads, so 1 nF = 0.001 µF = 1,000 pF. When you see a "1N5" capacitor listed, it is 1.5 nF or 0.0015 µF.

Write to Fat Quarters Software for their catalog sheets and tell Erich Kearn "Hi" from me.

Number 54 on your Feedback card

HOMING IN

Radio Direction Finding

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Globetrotting Foxhunters

Enhancing international goodwill is one of the main reasons ham radio exists. The words are right there in the Basis and Purpose paragraph of the FCC rules governing our service. The many good deeds of hams in the past have helped protect our bands during international spectrum allocation conferences.

Most hams think international goodwill only refers to DXing, contesting, and emergency relief communications on the bands below 30 MHz. But you don't have to upgrade to General Class or higher to be an ambassador for ham radio. Even if you're still studying for your license, you can get involved in radiosports and compete in a worldwide arena.

Regular "Homing In" readers know that radio-orienteering is a growing sport for all ages. At international style "foxhunts," a number of low-power transmitters are hidden in a large wooded area. Using simple radio direction finding (RDF) equipment, along with a map and compass, competitors attempt to be the first to visit all of the "fox" transmitters and get to the finish line.

For all the basics of radio-orienteering, which is often abbreviated ARDF, read "Homing In" for December 1995 and January 1996. There you will learn about efforts to hold international-rules foxhunts here in the USA. This month, I'll cover championship foxhunting worldwide and tell you about stateside hams who are going abroad to get involved in it.

Photo A. Fifteen-year-old Steve Ewing KB7MFO went on his first foxhunt in Khabarovsk. Though inexperienced, he was speedy and ended up being the second-best American finisher. (Photo by WA7VTD.)

Portland pioneers

Seven years ago, a group from Portland made ham radio history by being the first from our country to participate in a multi-nation foxhunt. The event was held in Khabarovsk, a city in Asiatic Russia, under the auspices of the Friendship Amateur Radio Society (FARS). A part of the International Sister Cities program, FARS has forged a strong link between hams in Portland, Oregon; Tokyo, Japan; Victoria, British Columbia; and Khabarovsk. Every two years since, FARS has held the Friendship Radiosport Games, an international get-together featuring a variety of contests, including a 2 meter foxhunt.

The most recent Games were held last year in Khabarovsk. Kevin Hunt WA7VTD was one of USA's Team Captains. "This was the best trip ever," he told me. "They pulled out all the stops. The games took only four days but we were there for two weeks. We took a side trip to Vladivostok on the Transylvania railroad, went fishing on islands on the Amur river, had parties, dined on caviar, fresh fish and delectable home-grown vegetables. The government underwrote a large portion of the costs of hosting the games. We were welcomed by the Vice-Governor of the Territory."

Others from the Portland area who traveled to Russia for the 1995 Games were Rene Berblinger KX7Z, Dick Fredrickson WAØDIM, Dan Early WA6IRO, Steve Ewing KB7MFO, Dale Mosby N7PEX, and Mary Jo Mosby KB7NJE.

ARDF is a regular ham radio activity in many parts of Russia and is the most popular use of the 2 meter band there. One member of the Russian team teaches foxhunting in his country's schools. Therefore, it was no surprise that the foxhunt course was difficult and the Russians were fierce competitors. Besides the Russians, Kevin and his team were up against two teams of Canadians, who have been practicing hard to improve their foxhunting skills since FRG-93 in Victoria.

Photo B. For the official Region III Championships photo (Queensland, Australia), the competitors stood behind their societies' markers. At left is Kevin Kelly N6QAB representing the USA. (Photo by Susan Kelly.)

According to Canadian team member Perry Creighton VE7WWP, "The exact rules for the Khabarovsk hunt were not announced until the last moment. The competitors were trying to figure them out as they stood on the starting line." As it turned out, rules were quite similar to International Amateur Radio Union (IARU) standards. The minimum age for the Old-Timer category was 42 instead of 40. Instead of a distinctive punch at each fox, there was a concealed official who would mark competitors' cards with a secret initial.

VE7WWP continues, "The foxes were well hidden. The orange markers (prisms) were supposed to be visible within five meters, but in one spot they had the fox buried under a pile of leaves. The official was watching from a tree a ways away recording numbers. Some people spent a half hour looking for that particular fox, then gave up and carried on. That created a bit of consternation.

"I went right up to one strong signal location, walked around it for about 20 minutes and finally got disgusted." WA7VTD told me. "I ended up going overtime and getting disqualified. On the other hand, WAØDIM was cynical and decided that it simply had to be in a big pile of blackberry bushes. He got down on his hands and knees and suddenly he saw a pair of eyes. There was a Russian soldier in camouflage buried under the big pile of brush. Dick stuck his card in there and the guy just smiled and marked it."

The foxhunt site was a large section of thick forest near Camp Dubkii. Total course length was very long, about 10 kilometers, with five fox transmitters. "Athletes found it necessary to DF their way back to the continuously-running finish-line fox," Kevin says, "because tree density on the course rendered map navigation nearly impossible."

The difficult course and well-trained opponents resulted in a bad day for the red, white and blue. Anatoly Kozurov stunned everyone by finding all of his foxes and crossing the finish line in 50 minutes. He narrowly edged out second-place winner Alexander Turkin, who won eight other gold medals in the Games.

One shining star for the USA was 15-year-old Steve Ewing KB7MFO (**Photo A**). "It was amazing!" says WA7VTD. "At the last minute I explained to Steve how to use the Russian RDF gear. He had never done foxhunting or any kind of contesting, but he ended up the second best American foxhunter at the match."

Both Canadian teams did better than the USA teams. "We are very serious about foxhunting," Perry says. "We practice each week in Victoria. I believe we proved that we can run with the Russians in the woods. Our problem was not equipment, it was legs. None of us were under 42, some of us are hitting 60, and one of our guys is 75."

WA7VTD told of some unexpected events during the hunt: "Two contestants surprised amorous

couples in the deep woods. Russian competitor Oleg Stavitsky stumbled across the day-old corpse of a homicide victim. The militia and police graciously allowed the hunt to be completed prior to removing the body. A suspect was arrested the next day."

Many of the USA participants had been to Khabarovsk for the first Games in 1989. "Although prices of goods are more realistic and goods themselves are in greater abundance, the upheaval of the past five years has created many homeless people and organized crime is thriving," Kevin says. "Most Russians earn less than $100 per month and government support of medical care and education is being dismembered. Nonetheless, our enterprising ham colleagues continue to find ways to make ends meet. The hospitality shown to the visiting hams was nothing short of spectacular.

"We were hosted by the families for one week and then put up for one week at a hotel," VE7WWP adds. "It was very enjoyable. I wouldn't have missed it for the world and I have every intention of going back on another visit."

A championship Down Under

The route to a world championship gold medal in radio-orienteering is through the IARU. Member societies sponsor national championships and they collaborate to put on championships at the Region and World levels on a rotating basis.

There are three IARU Regions: I is Europe, Africa and former USSR countries; II is North and South America; III is the rest of Asia and the South Pacific. IARU Region II has no official ARDF activities, sad to say, but contestants from our continent are welcomed as "friendship" category competitors in all IARU sponsored radiosports events.

Avid transmitter tracker Kevin Kelly N6QAB of Lusby, Maryland, has family ties to Australia, so he planned his 1996 vacation there to coincide with the IARU Region III championship in Townsville, on the northeast coast of Queensland. Kevin and I exchanged E-mail with Region II IARU officials and obtained authorization for him to be the official representative of the ARRL (the USA's IARU member society) at the championships (**Photo B**). As a result, Kevin says, "I got the royal treatment."

China is the leading ARDF proponent in Asia. That country has been active in the sport for many years, holds many internal competitions and has excellent radio-athletes. Kevin says Region III Championships Chairman Wally Watkins VK4DO learned about ARDF when he was stationed in China. Since then, Wally has played an important role in bringing it to Australia. China was well represented at Townsville, as well as Korea, Japan, New Zealand, Australia, Poland, Kazakhstan (**Photo C**) and Bulgaria. Also present were observers from Thailand and Malaysia.

The Championships lasted for four days. The first day featured a practice run on the University grounds with just two foxes (**Photo D**). The second day was the 2 meter competition. Then there was a day of rest and ceremony, including a reception with the mayor, followed on day four by the 80 meter competition.

Each competitor provided his or her own RDF gear. There were wide variations among sets from different countries. "The Koreans had different colors of fluorescent paint on their antenna elements," Kevin says. "It looked like they were using some exotic archery gear."

Exact sites were not announced in advance. "For the 2 meter hunt we met in a parking lot," N6QAB reports. "Buses showed up and we had to get on them. Nobody was allowed to drive. The bus took 45 minutes to get to the start point, somewhere near Mt. Louisa. They had it all set up with a covered awning and special places for the gear of each country. Once you left the start you could not come back to it, period. You put all the stuff that you weren't going to take with you in a plastic bag and gave it to them. They carried all of it to the finish point.

"You didn't have to find the foxes in order," Kevin continues. "I came out of the starting corridor and there was one strong signal right in front. The next fox was on the same bearing line, so I figured I'd take two at once. As I went along, it becamc apparent that the rest of them would be on the return trip.

"I went over a hill, walked a while, scaled another hill, and finally just over the rise I saw a couple of referees. I became intent on watching them, thinking they were watching the fox. Bad assumption! I walked right by it and spent two full five-fox cycles

Photo C. *The Kazakhstan team came from the Higher Radio Engineering and Radio Sports School. At left is UN7JR, the foxhunting teacher. (Photo by N6QAB.)*

Photo D. *The Australians built unique dual-band foxes for the Championships. An 80 meter wire antenna is shown here. For 2 meters, the wires are disconnected and four horizontal whips are mounted to the insulator atop the box. (Photo by N6QAB.)*

looking where I was probably within kicking distance. In heavy brush, that red flag doesn't mean squat unless you're right on top of it.

"At the next fox, the judges were hiding, but I saw a purple bag about a hundred yards away from me. I thought, 'That's not naturally occurring.' Sure enough, about 10 feet from that was the prism. As I went to it, they popped up from a crevice about 10 feet from me and waved.

"For the next transmitter, I had to go cross-country, away from the trails. All of a sudden there was a little shack with all kinds of stuff around it. Some guy was sitting out in his yard looking like a prospector. I could see where he had been doing some shooting. But there was no fox there.

"This was a lot longer course than any other foxhunt I had been on, even though I was taking the right route. A signal would be really strong and I kept thinking I was close and then there would be another hill to go over. I kept saying to myself, 'Hey, I'm in the Old-Timer category,' and I was liking it because I only had to find four of the five transmitters.

"I was being very careful not to go over the two-hour limit and disqualify, but I exerted so much that I started getting cramps in my legs. This never happened before. I had really good bearing on the fourth fox. I think it was on top of this really big hill, but I had only 20 minutes left so I gave up and headed for the finish line."

As **Table 1** shows, the Chinese were the big winners. Even though N6QAB didn't find all his foxes, he fared better than some contestants. "One of the New Zealand guys broke his ankle in three places," Kevin reported. "He was really laid out, but he still had his sense of humor. A Japanese hunter fell and hit his head. He came running through the finish line with a big red headband. After I made some comment about it, he took it off and there was blood all over."

There was plenty of non-radio fun at the Championships, too. Delegates visited the Billabong wildlife sanctuary, mountain biked and rode scooters on islands and beaches. "Almost every competitor was a licensed ham," Kevin says. "A lot of them didn't speak English, but English was the official language. The headmaster from Kazakhstan spoke excellent English. One fellow from Poland spoke Russian and interpreted a lot for me."

Future opportunities

The two Kevins and all the others who have taken part in multinational radio-orienteering competitions know that these events are unmatched for enhancing ham-to-ham international goodwill. There are plenty of upcoming opportunities for you to get involved in the sport. The next IARU World ARDF Championships are scheduled for Bavaria, Germany, in September 1997. If you are interested in attending as an observer or participant from North America, contact me and I'll try to help get your credentials.

FARS-Tokyo will host the next Friendship Games in 1997. The organizers will host 10 participants from USA and 10 from Canada; all others may participate unofficially. FARS chapters in USA and Canada are planning a North American Open Foxhunt to select members of the respective teams for the Tokyo meet. To find out more about this and other FARS activities, write to FARS, PO Box 13344, Portland OR 97213. FARS may also be reached via packet radio: KC7LRM@W7KYC.OR.USA.NOAM. Canadian foxhunters should contact FARS-Victoria via Perry Creighton VE7WWP, 4011 Hollyridge Place, Victoria BC Canada V8N 5Z8, or send E-mail to fars@bc.sympatico.ca.

I hope your club is planning its own international-rules foxhunts to promote the sport and give members a chance to practice and learn the skills. See the two-part "Homing In" series in the August and September 1996 issues for details on how to put on such events. Also check the "Homing In" web site (http://members.aol.com/homingin/) for more help, plus the latest news of upcoming ARDF events and links to ARDF sites in Europe and Asia. Let me know about meets in your area well in advance, so I can help spread the word. Send E-mail to Homingin@aol.com or postal mail to the address at the beginning of this article. 73

Category	T's	Best Time	First Place	Second Place	Third Place	Team Champs
2m Seniors	5	50:06	China	China	China	China
2m Juniors	4	49.31	Korea	Japan	Korea	Korea
2m Women	4	52:44	China	China	Japan	China
2m Old-Timers	4	69:03	Bulgaria	Japan	Japan	Japan
80m Seniors	5	40:22	China	China	China	China
80m Juniors	4	68:00	Korea	Korea	Korea	Korea
80m Women	4	48:18	China	China	Japan	China
80m Old-Timers	4	58:36	Korea	Japan	Bulgaria	Korea

Table 1. *Medal winners at the IARU Region III Foxhunting Championships in Townsville, Australia.*

HAM TO HAM

Your Input Welcome Here

Dave Miller NZ9E
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It's the December issue already, and probably the right time to turn most of our concentration toward warm indoor activities, at least here in the frozen Northland!

Net nite adventures!

From William Thim N1QVQ: "This idea may not be totally new, but bears repeating just in case some may not have heard of it... it concerns some operational suggestions for 'Emergency Practice Nets.'

"When the net control station feels that his or her net members are ready, try not starting the net on time and see what happens! You should have a back-up net control station. How long will it take your backup to jump in and assume control of the net? On a different occasion, prearrange with your backup to also not take over then see how long it takes for one of the participants to assume the reins. These 'readiness' tests may seem a bit deceitful at first, but they are good hallmarks of the net's ability to 'run itself,' as it well might have to during an actual emergency.

"We all get used to having things happen in a comfortable, familiar way, but that's not always to be expected in a true emergency situation, because an emergency—by its very definition—is itself unpredictable.

"Here's another test: Try telling all of the check-ins that your emergency battery power is failing, to please recheck-in again five minutes from now, and then see how many actually do. During actual emergencies, you may not have time to fully explain a situation and the net members will have to comprehend something unusual quickly, and follow your suggestions without any further guidance.

"Still another good test would be to tell everyone that they've just lost their normal antenna setup and to check in as soon as they can on their back-up antenna—however simple that might be. Perhaps some stations will have to relay for others who can't be heard by net control; how well is this handled?

"Finally, and this test applies to VHF/UHF repeater emergency nets, announce that the repeater will be turned off, simulating a loss of power at the repeater site. Again, stations will have to be ready to relay for each other and be able to copy weak and noisy signals from around the normal net area, proving that in actual emergencies copy may not always be 'armchair-clear' during times of distress. How well does this work?

"There are probably many more test-worthy scenarios that could be explored by inventive emergency net control ops and members alike, that will add realism and adventure to what might otherwise be routine net nights... while also providing a truer yardstick of how well your emergency net really is trained in its own emergency preparedness."

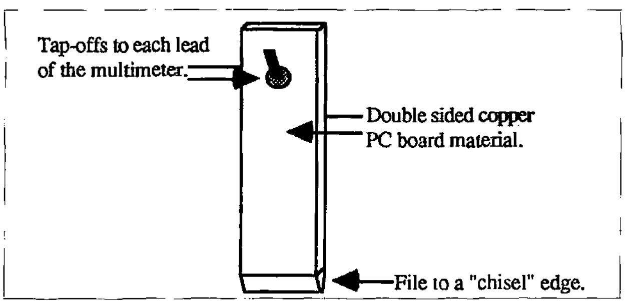

Fig. 1. K9KPM's "Battery Paddle." The paddle is made of double-sided circuit board material for inserting between two cells in a spring-loaded pack to measure the total current being drawn from the battery pack. See text for details.

Paddle your batteries

From Ken Guge K9KPM: "Have you ever wanted to measure the current drain from a particular piece of ham gear, or perhaps your daughter's portable tape player that's driving you close to the poverty level with AA batteries? I often thought that battery manufacturers ought to give these things away just to keep you in the high-volume battery-purchasing market. Well here's an easy way to put a milliammeter in series with those cells, without having to cut into the circuitry itself.

"Take a piece of scrap double-sided printed circuit board material (about 1/2" wide by 1-1/2" tall, and solder a short length of stiff wire on each side of the double-foil-sided board. These will be the 'quick' connection points for your VOM. Next, on the opposite end, file the 1/2" side down to a 'chisel shape' so that it will slip easily between two of the series connected cells in the spring-loaded holder (see **Fig. 1**). Now, when you insert this 'Battery Paddle' into the pack, you'll interrupt the current flow, but then hooking up your milliammeter will restore the flow and give you an accurate estimate of how much the little battery-eater is drawing.

"You can use this as a troubleshooting aid and know right away when you've cleared a high-current-drain problem or use it simply to check the battery drain for the sake of curiosity.

"If you make two of these paddles, you can insert one at each end of the series battery circuit, so that you can hook up a charger to the 'cell-side' of each paddle (being careful to observe the correct polarity), if you've decided to stop buying throwaway cells and use rechargeables instead.

"If you hook up a test power supply to the 'equipment-side' of each paddle (again, observing correct polarity) you can power the item from that external supply, instead of from the internal battery cells, for those times when it might receive extended use.

"I hope that this idea proves as useful to others as it has for me."

Moderator's note: Good tip, Ken. By the way, here are some typical milliamp-hour figures for alkaline-manganese dioxide cells, directly from Duracell®:

AAA—1,120 mAh
AA—2,450 mAh
C—7,000 mAh
D—14,250 mAh
9V—565 mAh

Below are some typical mAh capacity figures for 9 volt batteries at different current drains:

600 mAh @ 5 mA drain
560 mAh @ 14 mA drain
546 mAh @ 26 mA drain

You can see that the mAh figures will vary a bit depending upon the actual current drain, higher current drain giving less amp-hour life, but they're still a good guidepost for general usage. When you measure the current drawn by a particular piece of equipment, using Ken's battery paddle idea, divide that figure into the total capacity shown above for the size of cells you're using to get an approximate idea of the number of hours of use to be expected from those cells.

"You can drag out the shovel and split open the ground, but why not let nature do some of the work for you instead?"

No-drip 9913

From Chuck Steer WA3IAC: "Belden 9913® coax cable and its clones have been known to change from a nice dry transmission line into a water pipe after repeated soaking rains, compliments of Mother Nature. This can be the combined result of the cable itself having an internal 'air' dielectric, coupled with a non-watertight fit between the cable and its outdoor connector.

"I've solved the problem at my QTH by always using a length of 3/4"-diameter heat-shrink tubing over the finished connector's back end, then wrapping the entire connection with Teflon® self-adhering tape. If you don't have a heat-shrink gun, you can always 'borrow' the XYL's stove for a few minutes to acquire the heat needed to make the shrink tubing good and tight over the rear of the cable/connector interface junction. Don't depend upon overlapping tape alone to seal this critical point."

Moderator's note: Chuck has a couple of good suggestions here. For the heat-shrink-tubing part, I've also had excellent results with the type of heat guns generally sold in hardware stores or home improvement centers—intended for use in stripping paint or for thawing frozen pipes. There's the large "gun" style and also a smaller "point-source" style (my personal favorite) that will handle most jobs around the electronics workbench. They're usually quite a bit less expensive than heat guns sold specifically for heat-shrink-tubing applications alone, so if it's dropped, the loss isn't as great. I use one of the small "point-source" heat guns for applying concentrated heat to a circuit part that I suspect of being overly heat-sensitive, and in general troubleshooting as well.

Recycling is "in"!

73 reader **Andrew Gretchenuk** sent in this innovative idea, along with the samples shown in **Photo A:** "Whenever I go to a garage sale, house sale or flea market, I keep an eye peeled for any enclosures that might have ham radio or electronics applications. One of the ones that I particularly watch for is normally used in the kitchen, and consists of three or four wooden canisters of the style that 'nest' inside of one another for storage. They often make great little speaker enclosures or general radio project housings (for receivers, meters, test gear, etc.). To adapt them to a project, I'll usually use the scheme shown in **Fig. 2** to give me a metal 'partial chassis' for parts mounting. The spacers shown in **Fig. 2** can often be picked up at hamfests, or you can obtain them from parts suppliers such as Fair Radio Sales of Lima, Ohio (Tel. 419-227-6573) or

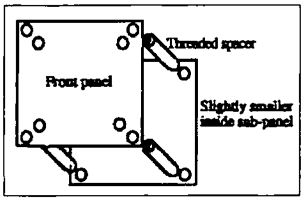

Fig. 2. Front panel and sub-panel (chassis) for use with a recycled kitchen storage box. See Andrew Gretchenuk's suggestion in the text for complete details.

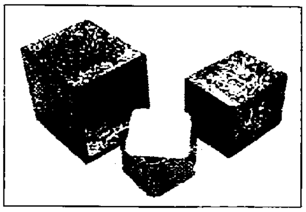

Photo A. The nested wooden kitchen canisters described by Andrew Gretchenuk are shown on the left and right sides of the photo. The repainted candy tin is in the center, painted "ham gray," of course!

The Electronic Goldmine in Scottsdale, Arizona (Tel. 1-800-445-0697). They can be obtained in various lengths from 1/4" on up.

"Another item to watch for at secondhand sales are metal cookie or candy tins. When repainted with metallic automobile spray paint, they often end up looking very professional and make excellent shielded enclosures (also shown in **Photo A**). Most are even directly solderable when buffed up a bit and soldering paste is applied."

Moderator's note: All good suggestions, Andrew, and thanks for sending the samples for photographing. Another source of handy very small "recycled" cases are those used to package Tic-Tac® breath mints; they'll hold a miniature remote toggle switch, a few small parts, or will act as a cable splice junction box. Either leave them transparent or apply a quick spray of your favorite color of "ham gray." It's best to put the mints inside of something else that doesn't make so much noise in your pocket anyway!

Pinned to the mat!

From Herb Foster AD4UA: "When the need arises to 'hide' radial wires or a small coax feed cable for an HF 1/4-wave vertical out on your lawn, here's a tip to keep in mind, one that I've used myself very successfully. Of course, you can drag out the shovel and split open the ground wide enough to accommodate those radial wires or RG-8X coax, but why not let nature do some of the work for you instead?

"Gather up a handful of wire coat hangers, the ones that seem to accumulate in closets as if they're breeding there! (I can't recall ever paying for a wire hanger... my XYL always seems to be able to produce a nice bunch for me upon request.) Once in

hand, use a sturdy cutter to clip off the hanger's normal 'hook' and straighten out the remaining length. Next, cut this straightened piece into 9" or 10" lengths and form a 90-degree (or more) bend—about an inch or so from one end—in each of these smaller lengths. Make up a bunch of these 'cable pins,' and push one down into the earth about every 15" or so along the radial or transmission line run. The 1" bend will 'pin' the wire closely to the ground and keep it there. If you've mowed the lawn somewhat on the 'short side' first, so much the better; the grass will grow up around the 'pinned-down' wire and your radials and transmission line will eventually almost disappear into the lushness of the turf. If done correctly, you'll be able to mow right over the radials and coax as if it weren't even there. This tip works equally as well at your home QTH as it does at a temporary 'ham-cation' spot!"

A better cube!

From Stephen Reynolds NØPOU: "Most of the inexpensive wall-mount plug-in DC power "cubes" that are available today have no internal regulation and will often sag to close to 50% of their labeled voltage when loaded to near their labeled current rating. Some items of equipment (if they have their own internal regulation) will work correctly when powered by these 'cubes,' but other items won't. Applying too much or too little voltage to certain accessories can be risky at best but here's a way around that potential (ouch!) problem!

"DC-to-DC automobile cigarette lighter adapters can be found that will lower and regulate the normal 12 volt DC car battery potential down to some other (often selectable) value... and these little gems can also be used on the 120 volt power 'cubes' mentioned above. Just be absolutely sure that you observe the correct input and output polarities, and that the current drain expected doesn't exceed the rating on either the power 'cube' or its DC-to-DC regulator add-on. Take a look at the Radio Shack™ catalog if you haven't seen the DC-to-DC adapters I'm referring to; the catalog shows several that are applicable."

Moderator's note: You might also consider building up a small external regulator using one of the many fixed voltage regulator chips on the market today. They're available in several size and current ratings and are extremely easy to put to use. The 78xx family of 1 amp positive voltage regulators in a TO-220 case (as shown in the drawing of ***Fig. 3****) can be commonly found in these standard fixed output values:*

7805T—5 volts
7806T—6 volts
7808T—8 volts
7812T—12 volts
7815T—15 volts
7818T—18 volts
7824T—24 volts

You can also incorporate an adjustable regulator, such as the LM-317T, shown in last month's column.

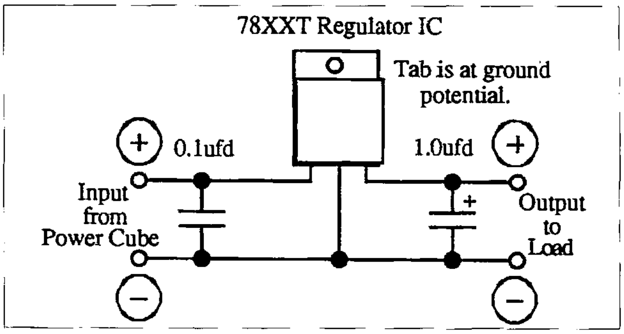

Fig. 3. *A 78XXT series regulator chip can also be used to stabilize the power output from an inexpensive DC wall power cube. See the "Moderator's note" with NØPOU's tip for further details.*

Fabulous ferrite

From Jim Kocsis WA9PYH: "Have you ever noticed how generally poor the AM sensitivity is on most of today's small portable transistor broadcast band radios? The sensitivity on the FM band is usually much better because this band uses either a telescoping whip antenna, or perhaps a fairly long headphone cord, allowing the capture of a reasonable amount of usable signal... but the AM band is a whole other story.

"The sensitivity on AM is limited by the effectiveness of the built-in ferrite rod antenna used for AM band pick-up. As the size of the radios has been shrinking, so has the ferrite rod's length—often ending up to being only a couple of inches long. I have a "super" AM radio that contains an 8"-long ferrite rod antenna, and it runs rings around the smaller radios... primarily because of the longer rod.

"Not wanting to have to carry the larger radio around, I decided to experiment a bit. I tried positioning just a ferrite rod, about 8" long, at various points around my little radio's case and found that reception could be markedly improved. You can find these larger ferrite rods at hamfests, garage sales or flea markets (the salvaged parts of older AM radios or perhaps the entire defunct radio itself). Simply strip off the coils of wire, then find the best spot on the outside of your small AM portable—where the signal is enhanced significantly—and using a rubber band to hold the 'auxiliary signal booster' in place, get ready for greatly improved performance. The flat ferrite form will give you the lowest profile, of course, but the round rods work well too. Be careful handling the ferrite material, it's very brittle and will easily snap if dropped or mishandled. Give the idea a try, it might just make you the 'hero of the day' to your wife or children (grandchildren?)."

This ends another month of "Ham To Ham." From KA9UCK (Sue) and me, all the best of the Holiday Season's joys and happiness. I hope that Santa brings you some interesting ham radio toys... remember, gals, men like toys as gifts, not clothes! We're actually just little boys in bigger jeans!

And now that winter has set in to stay for a while, why not sit down and write a brief description of some of the things that you've found useful in the pursuit of your own ham radio interests? I'll share them with the other *73* readers through this column in the coming months. Items of interest for spring and summer projects would also be appropriate to send in now... magazine lead times are fairly long. Please send all tips, suggestions, ideas and shortcuts to the address at the top of this column. See you next year! 73 de Dave NZ9E.

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NEVER SAY DIE

Continued from page 49

looking forward to it. Most report coming into contact with a supreme being that radiates love. Most are told they have tasks to do on earth before going to "heaven" and so must return until it is their time. While most of them become more religious, few continue going to organized religion churches. They come back with the message that God isn't interested in theology. Most of them, while dead, undergo a life review where they experience what they felt and what the other people around them felt as a result of their actions. I have an ex-wife who's going to have a major problem with that, and not a few ex-employees.

Of course I can't help, while reading about these NDEs, looking back at my life to see how I might have done better. My total lack of interest in money has been a hardship for my wife, who is much more money-oriented. It's also been a magnet for those who would take advantage of my lack of interest and who have robbed me of millions. But, having (at least in my eyes) helped the world along with the development of cellular telephones, microcomputers, compact discs (better music), my record companies, and now (hopefully) with cold fusion, I feel my visit to earth has been worthwhile.

My love of amateur radio has been guiding me for most of my life. Sure, I get frustrated when I hear hams using bad language and being inconsiderate on the air. I almost got angry when the ARRL virtually destroyed the hobby 30 years ago in their move to generate greater visibility for the League with their so-called "incentive licensing." And my ability to forgive, forget, and love my enemies is sorely strained when people print lies and distortions about me. Shame on you, Fred.

Another, slightly older, book on NDEs is Dr. Moody's *The Light Beyond* (1988; $4.50; 205p). He even interviewed a number of children who'd had NDEs, with their stories all being quite consistent.

The reports are that a whole realm of the afterlife is set aside for the pursuit of knowledge. Well, I've got a good start in that direction. When I die it's going to take a trailer truck to bring my library... and I'm not going anywhere permanent without it. If I can't take my books and CD collection, I'm not going.

Closer To The Light by Dr. Morse (1990; $6; 237p) deals with children's NDEs. What does it feel like for them when they die? What do they learn? We're going to have to understand more about how time works because many NDE reports have to do with future events. You'll also enjoy Brad Steiger's *One With The Light* (1994; $5; 300p), which not only covers a wide variety of NDE reports, but shows how in every case the experience has substantially changed the people's lives.

If you've read very many biographies you know that many (most?) of our creative artists attribute much of their inspiration to the ineffable. Sousa said that all of his marches came to him when he was in a half-sleep state. They came full-blown, so all he had to do was get up and write them down. Many composers and writers tell similar stories. In *Neither Dead Nor Sleeping*, May Sewall (Bobbs-Merrill, 1920; 320p; $2.50 in an old bookstore) wrote that her deceased husband explained to her that spirits on "the other side" are responsible for these subconscious creative events.

There's a current spate of books about guardian angels. The recent TV programs on angels probably triggered this interest. In between reading Peter Graneau's *Ampere-Neumann Electrodynamics of Metals* I'll whip through Hope Price's *Angels*, a $5 Avon inspirational paperback which reports on hundreds of angel interventions. There are a bunch more angel books, all packed with stories of people who've been touched by them. Now, are you going to try and tell me that every single one of these people is totally mistaken? Give me a break!

No, I can't see auras or bend spoons, but I have no good reason to disbelieve the many people I know who claim to have done these things. There are a great many things going on that we have no good scientific explanation for. Can you assure me that not one person in history has ever been able to dowse? My grandfather, who was an inventor, taught me how to dowse. "Pop" was good at it. He also was a good inventor. You wouldn't see Citgo or Continental Can Company around today except for him. He knew a lot about everything, so I accepted dowsing and had no trouble learning how to do it when I was about seven. Alas, he was a heavy smoker, so he died when I was only 12. My grandmother, who didn't smoke, lived on almost 30 years longer. I'll have to tell you more about her sometime. She put me onto the Sewall book three years after she died.

Though I haven't had a near death experience, I still have a pretty good idea of what my mission in this life is. It's what I've been doing for the last 44 years as a publisher: sharing the things I've found fun and exciting with as many people as possible, and urging you to share what you've learned with me. So I'm on your case, urging you to do better. To lose weight and thus live a longer and happier life. To not smoke. And to be adventurous. To try new things. Go new places. Try packet. Try satellite communications. Try going on a DXpedition somewhere. Learn more. Read.

If your reaction is negative, remember that this could be an approach to life that you carry around with you. Life is more what you make it than a box of chocolates. If you're nasty, so will be the people around you. If you get on the air to have fun and meet new people, that's what you'll find, for the most part. When you run into an ill-mannered op try another frequency instead of getting mad or getting even.

One thing both the angel and the NDE reports all agree on is that prayer can be surprisingly powerful. It doesn't seem to matter what deities you believe in, just the act of praying has power to heal and change things. No, this is not a new concept and it doesn't mean that poor old aging Wayne is newly converted to any particular savior. I'm just telling you what thousands of people I've read about have reported.

As I'm writing this I'm thoroughly enjoying a CD of Louis Moreau Gottschalk's (1829-1869) music. His music was sort of a precursor of ragtime and he was the first internationally famous American composer. Though it's difficult for me to imagine, I suppose there are some people who might not find his music irresistible. His Tarantella, Résponds Moi, Ojos Criollos, Orfa, La Gallina, Bamboula, Grand Fantasia, and Pasquinade are incredible. If I can't get you to enjoy reading books and learning, maybe I can turn you on to some wonderful music. No, all you want me to write about is ham radio, right?

So what do you find the most exciting about amateur radio? What adventures have you had? If you've made even a hundredth the number of friends via the hobby that I have, it's paid off handsomely for you. That's probably what brings me back to Dayton almost every year. When's the last time you had a contact where you talked with someone for over an hour and you both hated to end it? I used to offer a certificate for long-winded contacts, the Real Rag Chewer's Club certificate (RRCC) for contacts over an hour. Let me know if I should offer that again.

Of course I used to offer a WAAS certificate for hams who'd worked 49 states. Worked Almost All States. Then there was my CHC Certificate Hater's Club for hams who hate certificates and promise not to go after them, and if they do, by chance get one, they promise to hate it.

Maybe it's best I don't write about amateur radio and just stick to my secret goals of trying to get you to have more fun, to learn, and shape up.

Grist

With several hundred of the Art Bell listeners sending for a book of my not-yet-published 73 editorials, I started rummaging through the back issues, pulling out my non-ham oriented comments and putting them together into books of about 50 editorials each, *Grist I* and *Grist II*. If you enjoy my stuff you might send for a few copies of these for any friends you have who might enjoy thinking. Yes, I expect this is pretty restrictive. When I think over most of my friends, hams or not, darned few of them seem to be much interested in thinking.

Maybe that's why, when I get someone on the phone or over the air who's obviously done some thinking and the homework to back it up, we can talk for hours. Golly, that's fun!

Anyway, Professor Green has been reading and thinking, and putting his reports into these editorials. I think you'll enjoy the

Continued on page 63

Number 62 won your Feedback card

Hams with Class

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Staten Island NY 10313-0006

Some Hands-On Fun

With the start of a new school year, most teachers and instructors of ham radio classes are looking for new activities and demonstrations to do in the classroom. Experience shows that hands-on demos and experiments are the most fun and therefore the most memorable to the children. This term I tried something new.

I allowed one of my classes to pick their own hands-on activity to demonstrate to each other. Each group consisted of four team members. They had two weeks to prepare a demo to present to the class. They had to research the activity and come up with an interesting presentation about the unit we were studying, which was about batteries.

Obviously, the criteria for setting up the groups and for the complexity of the project will be determined by the age and ability of the group. But the sixth-graders I did this with really seemed to love the idea of coming up with their own project. I gave them time to spend in our class research center and for "putting their heads together." They were off and running to local libraries as well.

The charts and diagrams that were submitted were simply excellent. Here are two of the eight activities that were very well received by the children.

How do batteries work?

"How Do Batteries Work?" was presented by two boys and two girls in the sixth grade. Justin had big illustrations of the inside of a battery and explained to the class that a dry cell battery consists of a zinc container, a chemical paste, and a carbon rod. A chemical reaction involving these three materials produces electricity. The battery stops working when all the materials dry up inside the battery. In rechargeable batteries the chemical reaction can be reversed.

Photo A. Sixth-grader Mike sets up a circuit with wires and a battery.

For this demonstration you'll need the following items: an LED, two dishes, vinegar, two pieces of zinc (silver coins may work), two pieces of copper (pennies may work) and wires. In this activity, the vinegar acts like the paste inside a battery. Lemons or pickles work as batteries just as well as vinegar. The metals and vinegar react together to produce electricity.

Set up the circuit with a piece of zinc and copper in each dish of vinegar. When the LED didn't glow at first, we connected it to the wires in the other direction, using alligator clips. The kids really had a good time trying the same demonstration with the lemons and pickles. Always remember that being able to have children associate learning with fun is a number one priority in the classroom.

Tanisha did her part by giving a brief background on the "First Batteries." She explained that in 1791 the Italian scientist Galvani noticed that a leg from a dead frog twitched when touched by metal instruments. Electricity was flowing between the metal and the fluids in the leg. This effect was seen by another scientist, Volta, who went on to invent the first battery. He used stacks of zinc and copper disks, separated by fabric soaked in saltwater.

Sockets and switches

The second demonstration had lots of illustrations to go along with it. Making clear and informative charts is a whole unit by itself with the sixth grade. This one was called "Sockets and Switches." Materials needed are: two wires with alligator clips, a bulb (2.5V) and socket, a battery (1.5V) and holder.

Henry reminded the class that electricity can only flow along an unbroken path. The battery pushes electricity all the way around the circuit. The voltage written on a battery tells you how hard the battery will push electricity around a circuit. If you double the number of batteries in a simple circuit, you double the voltage pushing the electricity around.

First the kids screwed the bulb into the socket. Next they put the battery in its holder, then connected the wires to form a circuit. The next step in this interesting demo required an extra wire with alligator clips, tape, foil, and a thick piece of cardboard. They proceeded to add the extra wire into the circuit. Then they made a switch by taping pieces of foil to the cardboard so that they overlapped. Next they connected the foil to the circuit with the free alligator clips. They could then make the bulb flash by touching the pieces of foil together.

Take a guess what this demonstration was the introduction to in my ham radio class. In my next column I'll report on some very simple hands-on telegraph keys. If you are a teacher who has done some exciting activities with ham radio classes, please send me the details along with the children's pictures so that we can share it with other instructors.

Number 63 on your Feedback card

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NEVER SAY DIE

Continued from page 61

collections of my past editorial musings. The books are $5 each. A steal. I'll bet you know a few people who might enjoy them. Great Christmas gift. Cheap, too.

Ham Radio Fun

Communications Simplified, Part 12

Peter A. Stark K2OAW
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Mt. Kisco NY 10549

The concepts of spread-spectrum date back some 50 years, and maybe more, but until recently the circuitry required to use it was so expensive that only the military found it feasible. In the last few years, however, spread-spectrum equipment has become quite common in many areas.

Consider the following example: Suppose your name is Kilroy, you were supposed to meet a friend in some room, and you want to leave him a message that you've come and gone. The problem is that you have an enemy, and you don't want her to know you've been there.

You could scribble "Kilroy was here" on the wall, but that's too obvious. (Besides, graffiti is ugly!) So you decide to leave a little note that reads KILROY WAS HERE. The problem is—where to put it?

You don't want your enemy to know that you left a message. Even if she knows, you don't want her to find and read it. Worse yet, your enemy might remove it, or perhaps change it to read KILROY WILL BE HERE. Or someone completely new might come into the room, need a piece of paper to write on, and scribble all over your note.

This is a problem that is faced by the military. When sending an important message:

(a) You don't want the enemy to know about it;

(b) If he knows about it, you don't want him to be able to read it;

(c) If he can read it, you don't want him to change it into something quite different; and

(d) You don't want a transmission from your enemy, or even someone else, to interfere with your message and prevent it from getting through.

So back to the room. You spot a telephone directory lying on the table, so you write your KILROY WAS HERE message into it. You put the K on page 55, the I on page 113, the L on page 38, and so on. In other words, you spread your message throughout the directory, hiding it amid the printing that's already there.

In order to find your message, someone would have to know exactly where to look for it. Your enemy won't know that; in fact, she may not even notice the extra few letters written in amongst the "noise" of all the other stuff in the telephone directory. But even if she notices the extra printing, she won't know the order to put the letters back into. (Obviously, though, you'd better tell your friend where to look!)

Now suppose someone else comes into the room and decides to leave another message in the phone book. This new person is very unlikely to pick the exact same pages that you did, so the new message will probably not interfere with yours. Even if, by some chance, a few of the page numbers he chose happened to be the same ones you already used, at most he might overwrite one or two of your letters. Your message might now read KILXOY WAR HERE, but that's still enough to get the message through—better than putting your entire message in one place and taking a chance on its all being obliterated.

This silly little example is actually quite useful in answering some basic questions. For example, how should you pick the page numbers on which to write? There are several ways:

(a) Roll some dice to get completely random page numbers. Nice, because that makes it really tough for someone else to figure out the sequence. It also helps to spread the message throughout the entire phone book. But now you will have to give the list of page numbers to your friend. These numbers would be random if there is no pattern to them—even knowing all the past numbers that were used, you can't predict the next few numbers.

"How should you pick the page numbers on which to write?"

(b) Build two sets of loaded dice—one for you, one for your friend—set up so they both roll the same numbers. You roll your dice to get a set of page numbers. Later, your friend rolls his set of dice in exactly the same way, gets the same numbers and bingo. These page numbers look random, but actually they are not—if you have the loaded dice (or know how they were built), you can duplicate the set of numbers at any time. Such a set of numbers is called *pseudo-random*.

(c) Come up with some other way of generating pseudo-random numbers. For example, there are digital circuits that can generate long strings of digits that

look random, but are not. Or there are math formulas that can do it. As long as you and your friend both have the same circuit or formula, you can duplicate the same sequence of page numbers.

(d) If you need to do this every day, should you reuse the same numbers each day, or should you start over with a different set? If your main aim is secrecy, then you should use a different set each day. But if you're just concerned with keeping down interference from or to other people, then reusing the same numbers every time can be enough.

Now let's see how this applies to radio signals. The traditional idea is to transmit a radio signal on a carrier with a fixed frequency, and to try to limit the bandwidth as much as possible to avoid interference to (and from) others. But a radio signal like this is easy to find (especially with a spectrum analyzer), and easy to interfere with or jam.

Spread-spectrum radio, on the other hand, takes that signal, spreads it over a very large band of frequencies, and does it in a way that looks quite random and unpredictable (but is not!) It is the very opposite of what communicators have been trying to do since the beginnings of radio.

Spreading a signal out over a large band of frequencies also has the effect of bringing it down into the noise. Consider a glass of water. If the glass has a diameter of, say, two inches, then it might be perhaps four inches tall. Pour the same amount of water into a glass four inches in diameter, and the water is now only one inch deep. Pour it on the basement floor and it spreads out over a large area, but becomes only a tiny fraction of an inch deep. In the same way, a 10-watt RF signal all on one frequency stands out like a sore thumb. Spread it out over a few megahertz, and the amount of power at any one frequency is so small that it's almost impossible to measure. It blends into the noise.

There are several different ways to spread the signal over a large bandwidth; the two most common are frequency hopping and direct sequence.

Frequency hopping

Frequency hopping is just what the name says—rather than continuously transmitting on one frequency, the transmitter is constantly hopping from one frequency to another. This can easily be achieved by using a pseudo-random number generator to drive a phase-locked loop. Both the transmitter and receiver must use the same number generator to make sure that each time the transmitter hops to a new frequency, the receiver will go there too.

Your signal actually uses a lot of bandwidth—it spreads out over a large spectrum—but any particular part of that spectrum is used only a bit. Not only is it hard to find such a signal, but it generates relatively little interference to others because it never stays on any one frequency long enough to really bother anyone. It also *picks up* little interference from others: If there is some other interfering transmitter on a particular frequency, your receiver will be on that frequency only a short time, probably not long enough to bother you or him. (And some frequency-hopping systems actually avoid frequencies that are in use by other systems.)

Frequency hopping can be used to send an analog voice signal, but during the times that the transmitter and receiver are hopping from one frequency to another, there would be short breaks or glitches in the signal which would be very annoying. So a more common approach is to use a *codec*—a coder/decoder which does an analog-to-digital conversion to change the analog voice signal to digital data—and then send the digital data in short but rapid bursts. Between the bursts the transmitter shuts off, switches to the new frequency, turns on, and then sends the next burst of data. The receiver collects the bursts of data, slows them down and converts them into a continuous stream of data which, when converted back to sound with another codec, results in continuous speech.

This method has one other advantage: Once the sound is in digital form, error correction can be used to correct for missing or wrong bits of data. In this way, even if two transmitters occasionally hop on the same frequency and interfere with each other, the error correction removes the resulting errors.

Direct sequence

Direct sequence spread-spectrum is completely different from frequency hopping. Let's go back to our analogy of

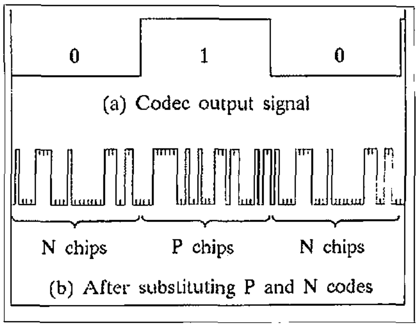

Fig. 1. Spread-spectrum chips.

hiding messages in a telephone directory. As we described it, each successive letter of the message KILROY WAS HERE went on a different page. This matches frequency hopping quite well, where each successive part of a signal is sent on a different frequency.

Direct sequence spread-spectrum (DS-SS) is not like that. Imagine that the telephone directory has 100 pages. Take K, the first letter of the message, break it up into 100 pieces, and put a little piece of it on every page of the book. Then do the same for every other letter of the message. At the end, every page of the directory has a tiny bit of every letter. In a sense, your KILROY WAS HERE message is smeared all over the book! That's direct sequence!

Let's use a spread-spectrum cordless phone as an example. Suppose you want to transmit a telephone-quality voice signal having a bandwidth of perhaps 3000 or 4000 Hz, between the handset and the base of the phone. With ordinary AM or FM, it could be sent in a radio signal with a bandwidth as narrow as 6 or 8 kHz (and even less with single-sideband.) With DS-SS, the process is a lot more complicated. We start by converting the voice signal into a digital signal with a codec. This typically gives us 64k bits per second of digital data.

DETOUR

A quick review: For resistors, a k is 1,000 ohms. For computer folk, however, a k is 1,024, so 64k would normally be 64 x 1,024 or 65,536, not 64,000. In this case, however, the number really is 64,000 bits per second, obtained by multiplying 8,000 measurements per second times 8 bits per measurement.

END OF DETOUR

If we ignored the fact that the 64k bps output of the codec has sharp edges (and therefore harmonics) and tried to modulate this onto a carrier the pre-spread-spectrum way, we would have a total bandwidth of 64 kHz.

Direct sequence spread-spectrum takes an extra step, however, before it modulates the carrier. It takes each bit of the data coming out of the codec and replaces it with a whole batch of new bits. In a typical spread-spectrum cordless phone, for example, each bit of the codec output is replaced by 32 bits. These bits break up each codec bit into 32 pieces called "chips." One set of 32 chips, called the *N code*, replaces each 0, while another set, called the *P code*, replaces each 1 in the codec output. In **Fig. 1 (a)**, we see the signal as it might come out of the codec. In **Fig. 1 (b)** we see what happens when the N code replaces the two 0 bits, and the P code replaces the 1. (In this figure, the N code for the two zeroes is the same; for greater security, more complex systems might change the P and N codes from bit to bit.)

"This can easily be achieved by using a pseudo-random number generator to drive a phase-locked loop."

Obviously, the resulting signal has much higher frequency components; in general, replacing the original bits with their P and N codes increases the frequency range by a factor of 32, which increases the bandwidth by a factor of 32 as well. In this case, the bandwidth goes from 64 kHz to over 2 MHz, much more than before. But this means that the transmitted power is spread out over a much wider bandwidth—sort of like spilling a glass of water on the floor. The same amount of power (or water) is still there, but by spreading it over a larger area the depth at any spot is very small. In some cases, the power may be so small that it's at or even below the normal noise level.

As you can imagine, a direct sequence spread-spectrum receiver is an interesting device. It starts off with a fairly normal superhet design, except that the bandwidth has to be wide—as wide as the signal. All of the interesting work occurs after the detector. Because the transmitted signal is spread out over such a wide bandwidth, the output from the detector (usually a phase-modulation detector) looks very much like noise. It would be almost impossible to recover the desired signal, except for one thing—the receiver knows what the P and N codes are supposed to look like! So it knows what to look for.

The circuit that looks for the P and N codes is called a correlator. *Correlation* is a mathematical term which describes how similar two things are to each other by comparing them, item by item. For example, suppose you toss a coin four times and get tails, heads, heads, and tails; call this THHT. If your friend tosses a coin and also gets THHT, that's a perfect match. You both got tails on the first toss, heads on the second, and so on. But note that this is not the same as THTH. THTH also has two heads and two tails, but they aren't in the same places—the first and second toss were the same, but the third and fourth are different. So only half of the tosses matched.

Now, suppose you toss a coin 100 times, and your friend also tosses 100 times. On the average, you'd expect 50 of your friend's tosses to be the same as yours, and 50 to be different. So if you get somewhere around 50 matches out of the 100, that doesn't show anything special; that's just the way random events happen. We'd say that this is *uncorrelated.*

But if all 100 of your friend's tosses exactly match all 100 of yours, that's suspicious. Sort of like two students who take a true-false test in a subject they know nothing about, and get exactly the same answers (some right, some wrong.) Suspicious, right? I would say that these two sets of answers are correlated—that one student probably copied his answers from the other. That's a correlation of 100% (or just +1.)

But what if the two students get answers that are completely different? Each time one answers TRUE, the other answers FALSE. I'd say that's also suspicious—almost as though one copied from the other, but purposely changed his answers because he decided the other chap was always wrong. In our case, we'd say this is -100% correlation (or just -1.)

So if two signals are very similar, the correlation is close to +1; if they are opposites, the correlation is -1; if they aren't related to each other, the correlation is 0.

Now back to a very simplified explanation of the direct sequence spread-spectrum receiver. The signal coming out of the detector is noisy, but at any instant that noise might be positive or negative. This voltage is sent to a capacitor, which averages that voltage over the length of one chip. At the end of that time, the capacitor voltage may be slightly positive or slightly negative, and the circuit uses that voltage to decide whether that chip seems to be a 0 or a 1. It then sends that chip into a digital circuit which stores it, as well as the 31 previous chips. In other words, this circuit (called a shift register) stores the last 32 chips that have come out of the detector. (The shift register always stores the latest 32 chips; each time a new chip comes out, the oldest chip in the register gets pushed out, so the very last 32 chips are always in the register.)

Now the correlator goes to work. The receiver knows what P and N codes the transmitter is using. So the correlator continuously looks at the 32 bits in the shift register, and compares them bit-by-bit with the 32 bits in the P code and the N code that it knows the transmitter used. Each time it finds a match, it says, "Aha! I got one!" (For those of you mathematically inclined, this process is called *convolution.*)

With 32 bits in a P or N code, there are 2^{32}, or more than four billion possible patterns to the code. So it's not likely that a random signal coming out of the detector is going to exactly match either the P code or the N code. For that matter, since the

incoming signal is noisy, it's not likely that even a fairly *strong* transmitted signal will exactly match the P or N code either. But if most of the bits match (and it's up to the designer to define what is meant by "most"), then the correlator reports that it has recognized a 0 or a 1.

So let's just review some of the key points of the system:

1) The correlator sort of takes a majority vote on the chips, so it tolerates a certain amount of errors. Even so, it will often make a mistake, so some additional error correction is usually needed.

2) The P and N codes have to be different enough that there isn't a likelihood of mistaking one for the other. Even their parts have to be different, and this means that only certain P and N codes can be used. Still, there are many possible combinations.

3) A receiver can only decode a transmitted signal if it knows what P and N codes the transmitter used. Other transmitters using different P and N codes, even though operating on the same frequencies, appear as just noise. While they increase the overall noise in the system, they don't really interfere with reception unless they are very near. Thus, many transmitters can use the same frequencies without interference to each other, and they are often difficult to detect.

The FCC has recently opened up three bands (902-928 MHz, 2400-2483.5 MHz, and 5725-5850 MHz) for unlicensed spread-spectrum operation. A variety of equipment, such as wireless headphones, cordless phones, burglar or fire alarms, and wireless modems, are already being marketed. There are even some integrated circuits which contain most of what you'd need for a simple spread-spectrum transceiver. Moreover, direct sequence spread-spectrum (under the name CDMA or Code Division Multiple Access) is being developed for cellular telephones as a means of allowing many more telephones to be used in a given area without interfering with each other. This is a big field, and getting bigger.

Digital signal processing

Another interesting new concept which may drastically change radio systems in the very near future is digital signal processing. A DSP (Digital Signal Processor) is essentially a specialized microcomputer IC, dedicated to processing analog signals. It takes an analog signal, converts it into digital numbers, processes the digital data in some way, and then converts it back into an analog signal.

Up until now, DSP circuits have been used in amateur equipment primarily to process the audio. For example, a DSP can analyze the received audio to identify constant signals (such as the whistles produced by interfering stations) and remove them. It can do the opposite too—identify those signals which represent voice signals, and amplify them more than other signals. In this way, the DSP has been used primarily to remove interference and noise.

As another example, several companies now manufacture noise-reduction headphones. Mounted on the headphone is a small microphone which picks up outside noise. A DSP circuit analyzes that noise, and then sends an equal but opposite signal to the headphone. This opposite signal partially cancels out the outside noise, reducing the noise level. The concept has also been used to counteract machinery noise.

Up until recently, DSPs have been plagued by slow speed, with the result that they could barely keep up with audio frequencies. But recent advances in DSP technology have speeded them up to the point where they are becoming fast enough to work at IF frequencies in receivers. This opens up an entire new area for them.

A number of manufacturers are working on receiver designs that consist of just three analog parts—an RF amplifier, oscillator, and mixer. The IF output from the mixer would then immediately be digitized by a DSP, and all other functions, including IF amplification and filtering, and detecting, would be done digitally.

The idea is actually driven by cellular radio. A cellular site normally needs a number of receivers, all tuned to different frequencies. Using DSPs would eliminate all this, replacing it with one RF amplifier, one oscillator, and one mixer. The resulting IF signal (which would actually contain a number of different received signals at the same time) would then be processed by several different DSPs, each one recovering the signal from one mobile or handheld cell phone user. When a cell phone switches from one frequency to another, instead of the cellular site having to switch receivers, the DSP would simply be reprogrammed to recover a different signal.

"Today's criminals can use these same techniques to avoid detection and capture."

The whole concept is still brand-new, and in its infancy. But we can expect the typical radio receiver five or 10 years from now to be very different from today's superhet!

Conclusion

As you can see, interesting and exciting things are happening in radio today. The advent of spread-spectrum communications is turning the industry around. Forty years ago, when CB or Citizens' Band radio started, so many people started using it that interference (and bad operating) made the band a shambles. Now spread-spectrum makes it possible for large numbers of people to share the same spectrum space without really interfering with each other.

Potentially, this is a tremendous improvement, but it can also lead to some problems. Just like the military developed spread-spectrum use over the years to provide security from detection, so today's criminals can use these same techniques to avoid detection and capture. I guess there isn't much we can do about that.

CW Enhancer

Making your signal stand tall.

Parker R. Cope W2GOM/7
8040 E. Tranquil Blvd.
Prescott Valley AZ 86314

When we listen to CW we would like to hear a "single signal," which means eliminating all the interfering signals. Eliminating all the undesired signals isn't really possible and we have to be satisfied with making the desired one stand out from the crowd. The filter described here does just that. It is tunable from below 300 Hz to above 3 kHz and has bandwidth variable from below 50 Hz to more than 5 kHz. The filter may strain out the signal but it doesn't strain the budget. It uses only one quad op amp (an LM324, available from Radio Shack™) and a few common resistors and capacitors.

Design equations are given to permit building filters for other applications in the audio frequency range. Of course, it's not necessary to understand the theory to build a filter that can improve your receiver's performance, but understanding the parts' functions allows adaption and use of the parts at hand.

The best filter for a receiver is a compromise of performance, complexity and cost. At first it would seem that a filter passing only a very narrow band of frequencies would be ideal. But using a very narrow filter in a receiver requires a slow tuning rate—if the receiver is tuned too quickly it can pass over a desired signal. A narrow filter also requires frequency stability in both the receiver and the transmitter. Some receivers drift for a few minutes (or hours) before they stabilize, and who can tell what the transmitter might do?

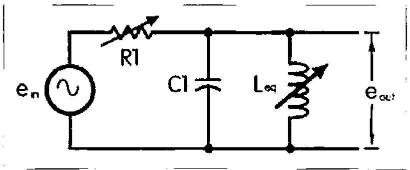

Fig. 1. A conceptual audio filter.

The CW Enhancer's center frequency and bandwidth can be adjusted to accommodate varying band conditions, and it has adjustable off-frequency rejection which is achieved by combining a portion of the full-bandwidth audio output of the receiver with the narrowband output of the filter. The narrowband signal is enhanced when the level of the full-bandwidth signal, including interference, is reduced relative to the narrowband signal.

"The active filter probably offers the best compromise for a multi-octave audio filter."

Filters come in many shapes and sizes, each with its own set of advantages and disadvantages. All things considered, the active filter probably offers the best compromise for a multi-octave audio filter. The CW Enhancer is an active filter that requires no matched components and only one low cost quad op amp, one variable resistor to control frequency, another to control bandwidth, and a pot to control enhancement.

The conceptual audio filter shown in **Fig. 1**, while not particularly useful when a wound inductor is used, can serve as the prototype for a filter when an active variable inductor is used. The output across the tuned circuit is maximum at the resonant frequency. The resonant frequency of the filter is:

$F_o = 1/[6.28 \times (L \times C1)^{0.5}]$

where F_o is frequency in hertz, L is inductance in henries, and C is capacitance in farads. L can be found by rewriting the equation as:

$L = 1/[(6.28 \times F_o)^2 \times C1]$

The value of L needed to tune C1 from 300 Hz to 3000 Hz can be calculated with the second equation. C1 is arbitrarily chosen to be 0.01 µF and the value of L is found to be:

$L_{max} = 1/[(6.28 \times 300) 2 \times 1 \times 10^{-8} = 28.1H$

$L_{min} = 1/[(6.28 \times 3000) 2 \times 1 \times 10^{-8} = 0.281H$

The 3 dB bandwidth of the filter in hertz is:

$BW = 1/(6/29 \times R1 \times C1$

where C1 is in farads, and R1 is in ohms. When C1 is fixed, the bandwidth of the filter is controlled by the variable resistor, R1:

$R1 = 1/(6.28 \times C1 \times BW)$

Assume C1 is 0.01 µF, then a bandwidth of 50 Hz requires R1 to be 318k. The nearest standard potentiometer value is 500k. Therefore, when R1 is 500k, the nominal minimum bandwidth is 32 Hz. When R1 is 5k, the bandwidth is 3.2 kHz. A resistor in series with R1

will limit the maximum bandwith if the range of bandwidths needs to be restricted.

In the CW Enhancer the variable inductance shown in **Fig. 1** is synthesized with a General Impedance Converter (GIC), shown in **Fig. 2**. The GIC, comprised of A2, A3, R2, R3, R4, R5, and C2, replaces the inductance L. The inductor synthesized by the GIC has an equivalent inductance of:

$L_{eq} = C2 \times R2 \times R4 \times R5 / R3$

where L_{eq} is in henries, C2 is in farads, and the Rs are in ohms.

"The best filter for a receiver is a compromise of performance, complexity, and cost."

Since R2, R3, R4, and C2 can be made constant, the inductance L_{eq}, and consequently the tuned frequency, F_0, can be controlled by R5. When R2 = R3 = R4 = R5 = R the expression for L_{eq} reduces to:

$L_{eq} = C2 \times R^2$

The value for R^2 can be calculated to show the general range of values of the resistors required in the GIC. A convenient value of C2 is 0.01 µF and R^2 is calculated to be 2.81×10^9 to produce 28.1 H. Therefore, R is approximately 53k . Since 50k is the nearest standard pot value available for R5, R2, R3, and R4 are recalculated to be 56k. The value of R5 needed to produce 0.281 H is 500 ohms.

The CW Enhancer shown in **Fig. 3** uses a GIC to synthesize a variable inductor to resonate with C1 over the frequency range. The bandwidth is controlled by R1. A fraction of the full bandwidth audio signal, determined with the enhancement control R6, is summed with the output of the resonant circuit. The resonant circuit is isolated from the summing amplifier A4 by the non-inverting unity gain buffer A1. The "enhancement" control, R6, controls the level of the full bandwidth signal without changing the level of the filtered signal.

The output of A4 can drive 20 mA into a short circuit or swing a 1k load to within a volt of the rails. This equates to about 1.5 mW into low impedance (8 ohm) phones or 20 mW into 600 ohm phones. For more audio power Radio Shack's mini-audio amplifier P/N 277-1008 at $11.99 will certainly do the job, but a simple emitter follower as shown in **Fig. 3** is much less expensive and is adequate for most situations. The speaker or phones are capacitively coupled to eliminate DC in the load. A 100 µF coupling capacitor produces a low cut-off frequency of 198 hertz with an 8 ohm speaker. That is, the response at 198 hertz is down 3 dB (half power) from the response at 2 kHz. When 600 ohm phones are used, the coupling capacitor can be reduced to 2.2 µF.

The LM324 quad op amp shown in **Fig. 3** is pin-for-pin compatible with the MC4741. These ICs contain four independent operational amplifiers identical to the MC1741 packaged in one 14-pin DIP. Of course, the quad op amp can be replaced with four individual 741s if they are more available.

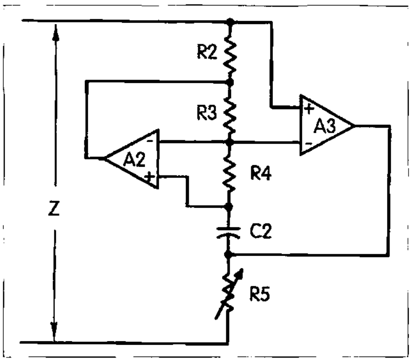

Fig. 2. The General Impedance Converter can look like an iductor. See text for formulas.

The power supply for the circuit is not especially critical; a 12 volt supply is convenient. When a 12 volt supply is tapped at 6V, the tap may be considered "local ground" and the op amps effectively operate from +6V and -6V. Of course, the +6V and -6V supplies could be developed idividually. The "local ground," V_R, is obtained by tapping a single 12V supply with R10 and R11 in **Fig. 3**. The +12 volt input is 6 volts above "local ground" and the

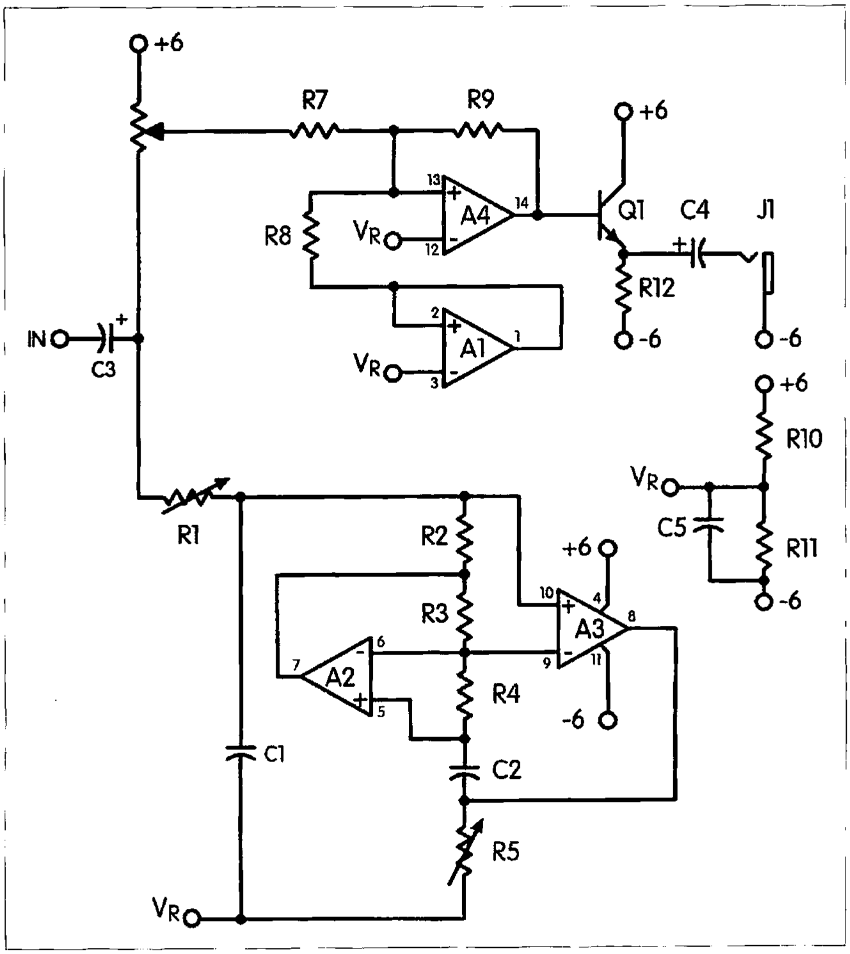

Fig. 3. The CW Enhancer uses GIC to synthesize the inductor in an audio filter..

negative side of the input supply is 6 volts below "local ground."

The maximum power into 600 ohm phones is limited by the supply voltage. With 8 ohm phones, the maximum power is limited by the peak transistor collector current. A different transistor with higher collector dissipation could supply more power if needed. Since the Enhancer's voltage gain is about unity, the maximum input from the receiver should be limited to about 3.5V (5V peak) with 600 ohm phones or 0.28V (0.4V peak) with 8 ohm phones or speaker.

The Parts List for the CW Enhancer of **Fig. 3** is given in **Table 1**. Most Radio Shack stores will special order the potentiometers from Radio Shack Unlimited (RSU). If not, they are available from any industrial electronics distributor, such as Digi-Key.

The CW Enhancer is a relatively simple project whose performance belies its simplicity. The three controls: "Enhancement," "Bandwidth," and "Frequency," enhance the CW capabilities of a basic communications receiver. Construction time is just an evening or two but the enjoyment it brings goes on and on.

Parts List

C1, C2	0.01 ± 10% µF film capacitor	Radio Shack # 272-0165
C3	2.2 ± 20% µF electrolytic capacitor	272-1435
C4, C5	100 µF electrolytic capacitor	272-1016
J1	1/4" single circuit 2-conductor phone jack	274-252
Q1	NPN transistor, $h_{FE} > 40$	MPS3904
R1	500k ± 20% 1/4W potentiometer	RSU
R2, R3, R4	56k ± 5% 1/4W fixed resistor	RSU
R5	50k ± 20% 1/4W potentiometer	271-1716
R6	5k ± 20% 1/4W potentiometer	271-1720
R7, R8, R9, R10, R11	10k ± 5% 1/4W fixed resistor	271-1335
R12	470k ± 5% 1/4W fixed resistor	271-1317
U1	LM324 quad op-amp	276-1711

Table 1. Parts list for the CW Enhancer.

Bill Brown WB8ELK
138 Angela Dr. Apt. B
Madison AL 35738

Just before sunrise on September 22, members of a group called HALO (High Altitude Lift Off) gathered at the old airport in Huntsville, Alabama, to fly an unusual balloon mission. This was part of an ongoing series of test flights to prepare for a rockoon flight this winter. The rockoon is a rocket launched from a balloon platform floating at 90,000 feet. Since this is above most of Earth's atmosphere, the rocket should fly briefly into space (over 60 miles high).

Also attached to the fuel tank payload was a low-power tracking beacon designed by myself WB8ELK, with a 68HC811E2 microcontroller which sent down CW altitude and temperature telemetry via a 147.45 MHz 2 milliwatt FM transmitter (audio CW) based on the Motorola MC2833P chip. In addition, the telemetry was simulcast on 28.800 MHz CW (20 milliwatts) using a keyed clock oscillator.

The balloon used was a special 19k cu.ft. Raven zero pressure balloon, which is quite different from the standard weather balloons used in previous flights.

"It was just like taking an elevator to the edge of space."

The flight system

The experiment payload consisted of a nitrous oxide fuel tank with pressure and temperatures probes inside to study the effects of the balloon flight. We need to maintain good pressure in order to fire our hybrid rocket from the balloon. The rocket is a hybrid consisting of a nitrous oxide tank and asphalt. Our ground-based launch of the rocket achieved nearly 30,000 feet last spring.

The ATV/telemetry payload was built by Ed Myszka KE4ROC and consisted of a live color TV camera hooked up to a PC Electronics KPA-5 ATV transmitter on 434 MHz (a microphone was attached to the audio subcarrier), a big wheel antenna built by Gobe W4WAD, and a sensor decode system consisting of two Basic Stamp IIs hooked to a GPS/Pico-Packet combo. Telemetry and position information was sent down in an APRS format on 145.79 MHz.

Ed mounted all of his electronics into a sturdy but reasonably lightweight aluminum frame of his own design and covered it all with Styrofoam™ for thermal insulation.

This balloon is made out of a plastic film with a vent duct in the bottom. At altitude, instead of bursting, it actually vents out the excess helium and will level off until sundown or until we cut it loose with a cutdown device.

Adventures in flight

As we laid out the balloon (70 feet long uninflated) on the pavement of the old airport runway, many of us commented on just how perfect the conditions were for our first attempt at such a large system. Not even the slightest breeze disturbed our efforts as we pumped almost four tanks of helium into the balloon envelope (approximately 1,000 cubic feet of gas).

After about two hours of preparation we were ready to launch. The balloon towered over us and was quite a spectacular sight as it reflected the early morning light. However, just as we were ready for liftoff, we encountered a problem with our rigging and retrieval system which required a trip back to the workshop to get some parts.

We sat there with a huge bag of helium for nearly an hour. Then, just as the crew returned with the parts, Mother Nature finally figured out that there was this big, beautiful balloon just sitting peacefully on the ground. She started to play with it with wind gusts, just like a cat does with a mouse. It was quite a sight to see everyone running around under the balloon trying to keep it from hitting the rough abrasive surface of the old runway. Unfortunately, one particularly strong gust caused it to graze the runway and tore two large holes in the side of the balloon. We taped the holes shut in the hope that it would hold throughout the flight, then launched it during a brief lull in the wind.

The balloon glided across the runway and the bottom payload promptly snagged on what

Photo A. The launch crew prepares the ATV telemetry and tank experiment for liftoff as the balloon is inflated. (Photo by Gene Marcus W3PM.)

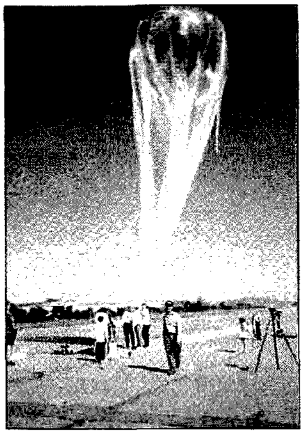

***Photo B.** The inflated Raven balloon stands nearly 40 feet tall. (Photo by Gene Marcus W3PM.)*

appeared to be a power line near the edge of the runway (see **Photo C**). There it was 20 feet up with the balloon sailing out like a kite. Fortunately, this turned out to be an unpowered audio line to some loudspeakers, so I got a long pole out of my car and was able to hook the radar reflector and drag the whole thing off the line. Ed KE4ROC grabbed hold of the payload, ran forward and gave it a big push. Everyone cheered and yelled when everything finally headed off smoothly on its way to the stratosphere after narrowing missing another set of real power lines. When we played back our videotape recording of the payload's point of view, it was quite entertaining to hear and watch everyone running around like crazy under the payload as we tried to free it from the line.

Elevator ride to space

The payload rose upward at a very leisurely 620 feet per minute. The video image was very stable, with absolutely *no* twisting or turning of the payload. Those zero-pressure balloons are nice! It was just like taking an elevator to the edge of space. Since it was a very clear day, the TV camera view of downtown Huntsville and the surrounding suburbs was fantastic. The APRS telemetry worked great and everything was operating smoothly except that telemetry from the pressure and temperature sensors inside of the nitrous oxide fuel tank was intermittent. At 39,000 feet we noticed that the balloon was starting to descend slowly (around 500 feet/minute). Apparently the taped-up holes had sprung leaks and were slowly letting the helium out.

Unidentified floating object

Since the payload was descending so slowly, we decided not to fire the cutdown mechanism to allow the system to fly farther into Georgia and land it closer to the Atlanta area foxhunters who were preparing to chase the payload.

Ralph Fowler N4NEQ organized a chase team to track down the payload. He had an APRS system in his car and we could not only track the balloon's position on our ground station back in Huntsville, but we could track his chase vehicle closing in on the payload as well.

After traveling 108 miles from the launch site, the balloon landed at 1:59 p.m. in a kudzu patch behind the back yard of a house southwest of Dallas, Georgia.

The owner of the house was washing dishes and saw the payload land in a field behind her yard. She thought that a UFO had landed and called the TV and radio stations in the area to report the sighting. She turned on her scanner to see if anyone else had reported the UFO, actually ran across the chase crew on 2 meters—and realized that aliens *weren't* invading Georgia.

The payload survived the landing in good shape and was handed over to Robert KE4GNN, one of our group, who had chased after the balloon from Alabama.

Post-flight results

We learned a lot about flying large balloons and received enough telemetry data to consider the flight to be a success. A balloon flight of this size requires lots of planning and coordination with the FAA. Launch permission needs to be received in advance and we were in constant contact via cell phones to both the local airport's tower and the regional FAA center. They were able to track the balloon system on their radar screens; apparently our radar reflector worked just fine (the reflector is available from Kaymont, 800-644-6459).

For more info about the balloon flight (complete with photos and charts) and details about the telemetry system, check out my home page at the following Internet web site:

http://fly.hiwaay.net/~bbrown/

This page also contains many links for balloon information and other groups.

***Photo C.** The balloon is shown attached to our telephone pole test facility to allow for a photo opportunity and final system testing. Attaching the payload to the phone line requires pinpoint accuracy during the initial launch phase. (I work for the government, so I can put a positive spin on just about any disaster!) (Photo by Gene Marcus W3PM.)*

Number 74 on your Feedback card

RTTY LOOP

Amateur Radio Teletype

Marc I. Leavey, M.D., WA3AJR
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Stevenson MD 21153

As I write this column, autumn has just begun, but our much-celebrated *Hagerstown Almanac*, published here in Maryland, says that this will be a cold, cold winter. If that's the case, some of the items covered this month should give some of us something to do while the snow melts. Now, with this magazine hailing from New Hampshire, and my living in Maryland, those of you with balmy December weather can just hold your peace.

"Some of the items covered this month should give some of us something to do while the snow melts."

Software for the Kaypro?

From up in New Hampshire I received a letter from Mike Murphy WB2UID, who says, "I have not been exposed to RTTY yet. My station plans are fairly simple, with a Heath Marauder and a Collins R-390A and SSB converter. The Heath is massive and has 100% duty cycle capability; it should work great. I like the idea of using my PC and some kind of filter/adapter circuit to do RTTY or AMTOR.

"I have an old Kaypro 2 (King of the CPM Z-80s?) with dual floppy drives under my workbench at home. Is this thing still useful as a RTTY or CW terminal? I fired it up and it runs WordStar! It is fully metal-shielded, sort of portable, and looks like it would make a nice rig to build a converter into—lots of space inside. Any chance that any CPM software still exists for the Kaypro?"

Well, Mike, there is, and then, again, there may not be. I did a search of available archives and while I turned up a bit of CPM software still around, only one program seemed to be applicable to your situation, a program called RTTY2.LBR. This is a "library" file, a precursor of today's archived or zipped file, that appears to contain RTTY routines for CPM. I have no way of extracting or looking at these files, so I pass along this information for what it is worth. Along with sending you the file, I pass along the information that other CPM files may be found at the Oakland University Archives, on the World Wide Web at http://oak.oakland.edu/oak/cpm/hamradio-pre.html. The files are also on the Oakland FTP site if that is more convenient for you. Additionally, I will have a link to the file on the Download Page of the RTTY Loop Home Page; see the address at the end of this column. Let me know if this file is useful to you, and how you do with the CPM efforts.

New DOS program

After CPM came DOS, of course, so, logically, we should take a look at a new DOS program. Well, you have got to see the new HamComm, version 3.1. This little gem, written by W.F. Schroeder DL5YEC, runs under DOS rather than Windows© 3.x, 95, or NT; or OS/2. It supports reception and transmission of radioteletype (RTTY), AMTOR ARQ/FEC, SITOR A/B, NAVTEX and Morse code (CW) signals. A decoder for SHIP and SYNOP reports from weather stations is also included. PACTOR decoding is available with the registered version. It does not require a RTTY converter, not even a modem chip. The audio output of the transceiver is connected to the serial port of any PC/XT/AT compatible computer through a very simple, low-cost interface. Only one IC is needed (Op-Amp TL071 or similar) and a few diodes, capacitors and resistors. Whether or not this would work with simple computer modems such as the CP-1, I do not know.

For transmission, a tone signal is available at the COM port which can be connected to the microphone input of the transceiver through a passive RC filter. Audio frequency decoding and serial/parallel conversion are all done in software.

HamComm will automatically detect the type of video adapter in use. MDA, CGA, EGA, VGA and Hercules are supported. All graphics routines are written in assembler for speed. No attempt has been made to avoid screen flicker (snow) on cheap CGAs.

HamComm may work to some degree on XT machines, but the graphics displays of the input signal are more fun to watch on an AT-class computer. Nearly all of the functions can also be controlled by using a mouse. A hard disk is recommended but not required. All texts are written in English, and the online help system includes the schematics for the interface circuit. There are also predefined standard phrases, a QTH distance/direction calculator and a callsign decoder. Currently about 370 kbyte of free RAM is required. The interface schematics are included in the online help texts and there is also a section on troubleshooting in case of hardware problems.

HamComm 3.1 is shareware, with a $30 payment due after a 30-day evaluation period. It is an excellent program, with a good track record in previous incarnations, and many "RTTY Loop" readers have used the program with good results.

You can obtain HamComm on the RTTY Loop Download page, as well as in the RTTY Loop Software Collection Disk #13. Details for obtaining this disk are at the end of this column.

Windows software

Windows users, we have not forgotten you. Gary Johnson KF7XP has just released an updated version of his XPWare for Windows Version 1.1.1. This new update supports AEA, Kantronics (KPC-3, KPC-9612 and KAM), SCS (PTC, PTC-Plus and PTC-II), PacComm (PTC and PTC-II) and Hal P38, PCI4000M and DSP-4100 multimode controllers. It allows transceiver control (with appropriate interface) for Kenwood, Icom and Yaesu (FT-767, FT-840, FT-890, FT-900, FT-990, FT-1000 and FT-1000MP). It supports DX cluster spotting, voice announcement on connects and DX spots, ANSI and Bit map graphics, one-key brag files and test. Callbook interface (SAM, QRZ!, Buckmaster and Radio Amateur Callbook), binary file transfers for Clover, GTOR, packet (YAPP) and PACTOR. The program can run one or two controllers at a time (may be different types and brands)—and much much more. Registration cost is $80; upgrade cost for users of XPWare DOS program is $45.

With one program able to do so much, this affordable program can be "test driven" by downloading from either the RTTY Loop Download Page or Gary's web site at: http://www.indirect.com/user/gjohnson . Gary's controller-specific versions under DOS have been fabulous; this one looks to be even better. Take a look if you are hunting for a flexible program to interface one of the supported devices.

For those who came in late, the Software Collection referred to above is a 13-disk assembly of programs of interest to amateurs on radioteletype. Each disk collection may be obtained by sending a blank 3.5" HD disk, a self-addressed, stamped mailer to return the disk to you, and $2 in US funds per disk to the address at the top of this column. A listing of the contents of each disk can be sent to you for a self-addressed, stamped envelope sent to the same address. Alternatively, you may find the complete list, and some programs, on the RTTY Loop Home Page at http://www2.ari.net/ajr/rtty/, where past columns, programs, and other trivia are available, along with links to other interesting sites on the World Wide Web. Let me know what you are thinking, via mail, or via E-mail at: ajr@ari.net, or MarcWA3AJR on AOL, or 75036,2501 on CompuServe. I look forward to hearing from you. See you in '97!

Number 76 on your Feedback card

Saving the Amateur Radio Spectrum

A case supporting amateur licensing fees.

Charles M. Seay, Sr. KN4HL
106 South Main Street
Dickson TN 37055

The amateur radio bands are under attack again, especially the 2 meter band and the 440 MHz band by LEO (low earth orbit) companies needing frequency space for new services. The need for more radio spectrum will accelerate in the future with the development of more electronic gadgets. What better place to look for more spectrum than the amateur radio bands?

Why should our bands be such a fertile area for commercial expansion? Because they are not a revenue-producing source for the federal government. The FCC and Congress have seen the enormous revenues that can be obtained from radio spectrum auctions. The more demand generated for radio frequency spectrum, the more valuable our bands will become.

Even though there are over 600,000 licensed amateur radio operators in the United States, these numbers are not significant enough to be politically powerful. Political power is based on numbers. The amateur radio community just doesn't have the numbers to protect its interests, either with the FCC or with the final authority, Congress.

The American Radio Relay League membership represents only a small portion of the licensed amateurs in this country. They are, however, the only game in town when it comes to representing the amateur community. Members are paying over 30 dollars a year for a magazine and no political clout when the final votes are counted. As an example, I direct your attention to the bill introduced by former Tennessee Congressman Jim Cooper, which was designed to protect amateurs from the loss of more amateur spectrum. Even with all its urging, the ARRL could not muster the support of enough representatives and senators to get this bill passed into law. Why? There was no economic incentive for members of Congress to pass such a bill.

"If you can afford a rig, you can afford a license fee."

Have you ever asked yourself why people and corporations make such big contributions to politicians running for office and their political parties? Or why groups and corporations are supporting thousands of lobbyists in a manner you wish you could afford? It is to have access to the powers that could control the economic destiny of that contributor. I can assure you that the presidents and CEOs of communications companies have more access and input to the decision-making process of the FCC and the Congress than the political arm of the ARRL. It's not that the presidents and CEOs are nicer than the president of the ARRL, it's a matter of money.

It's time that amateurs get their heads out of "OZ"; Dorothy and Toto do not exist. Your ability to enjoy the great hobby of amateur radio will come down to the U. S. Dollar. It will involve a decision on each of our parts to pay for enjoying our hobby.

What, *pay* for my God-Given Right to use the amateur radio spectrum? Yes, indeed. If you play golf, swim, hunt, fish, or ski, you pay a fee each year for a license, or greens fee, or a lift ticket. Why should amateur radio be given a free lunch? The bottom line is—we shouldn't.

I have heard the howls that we amateurs should not be charged a license fee because we provide a public service. This is true to a small extent. The fact is that

amateurs, as a group, don't do enough public service to justify the free spectrum. You've also heard that license fees would make the hobby unaffordable to some. Get real, pal. If you've bought any amateur gear in the past few years, you know that we are in an expensive hobby. If you can afford a rig, you can afford a license fee.

I think that a $50 fee for a five-year license would not be out of proportion with the other expenses we incur with our hobby. Small fees for changes of addresses and callsigns, and license exams would be appropriate. It is a matter of economic fact that if we want to play, we are going to have to pay our fair share.

Under the burden of this country's budget deficit, politicians are looking at every conceivable source for funds to support their pet projects. We amateurs can sit around, then bawl and bellow as our allotted radio spectrum is sold out from under us, or we can make our part of the radio spectrum economically justify its existence.

This proposal is not one-sided. With the payment of license fees, the amateur community has every right to expect that the FCC will do a better job of policing the amateur radio spectrum. It is time the FCC enforced their own rules, something they've been neglecting for several years. One of the reasons for this neglect is the lack of funding by Congress for this police action.

It all comes down to money. We complain to the FCC about the garbage on our bands and nothing is done because there is no money. We complain about the loss of our bands to commercial interests and we lose radio spectrum because there is no economic justification for our space. It's time we paid the piper—the dance is just about over.

Note: The above will, I hope, be a dose of reality salts for hams who are ignorant of how our government works. But $10 a year for a ticket is insignificant. To have any hope of clout against Motorola, G.E., Matsushita, Sony, Hitachi, Toshiba, et al., we're talking more like $100 a year. And that, if we can hold on to a half million hams, would still only be $50,000,000 a year—while the FCC is bringing in billions with their spectrum auctions. If we had to pay for our licenses we might have more respect and less trashing of our hobby on the air. We could also expect more help from the FCC with our garbage collecting. Most people just don't respect anything that's free! ... Wayne.

LED Checker Plus

Make it even more useful.

Tom Thompson
Box 49481
Blaine MN 55449

If you have already built the LED Checker (see *73*, January 1989, p. 61), then I have a simple change that will turn it into an even more versatile bench tool.

Several new options are available with the Plus model, such as in-circuit testing of LEDs including displays, polarity testing and identification of diodes, and an external DVM connection for forward voltage measurement, which is helpful in determining if a diode is silicon, germanium or a Schottky type.

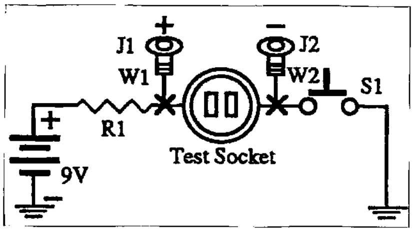


Fig. 2. The improved LED Checker Plus allows measurement of forward voltage drop, as well as in-circuit tests.

The original circuit

First, familiarize yourself with the original circuit (**Fig. 1**) The basic circuit is the same, except without the two jacks for external test leads added in this enhancement.

The operation is simple! Insert the LED into the test socket and press S1. If the LED is on, it is good. If it's not on, turn it 180 degrees and put it back into the test socket. Press S1 and the LED should be on. If not, it is defective.

The modification

See **Fig. 2**. The "Plus" model merely has wires W1 and W2 added to the original circuit directly to the "+" and "-" terminals of the test socket. These wires are then soldered to J1 and J2, a pair of five-way binding posts (RS-274-662). The red binding post should be connected to the "+" and the black to the "-." You can mount the binding posts wherever you want, but the industry standard is 3/4" between centers. Or you can also use banana jacks, which are less expensive.

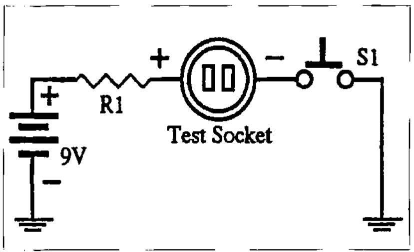


Fig. 1. The original LED Checker circuit.

In-circuit LED testing

See **Fig. 3**. For in-circuit LED testing you connect your clip leads "+" and "-," then clip them to the two LED leads and press S1. If the LED goes on then it is good. If it doesn't then you reverse the leads and press S1 again. If the LED is still not on then it is bad.

In some cases, if several LEDs are in parallel or there is too much current being drawn by the circuitry then you may have to unsolder one of the leads to isolate it from the rest of the circuitry.

Diode forward voltage testing

This testing is usually done to determine the voltage drop across the diode while it is on. To check diode forward voltage, connect your DVM to the Checker, red to "+" and black to "-." Set the DVM to DC volts on the 2 or

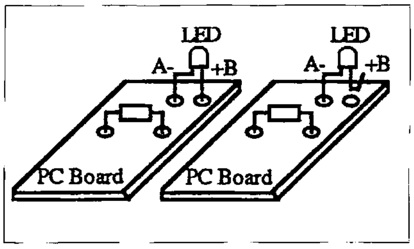


Fig. 3. The LED Checker Plus can be used in-circuit.

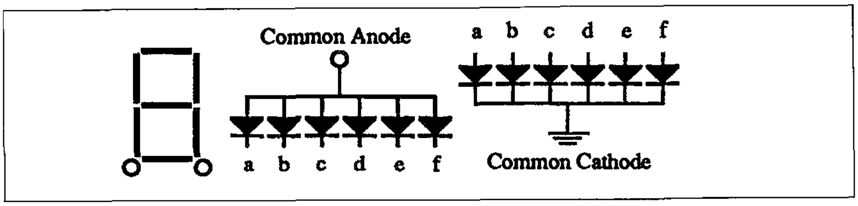


Fig. 4. Seven-segment displays are available in either common anode or common cathode configuration.

20 volt range (this will vary with different models of voltmeters). Put the diode into the socket and press S1. If the diode is in correctly the voltage measurement will appear on the display. If not, reverse the diode and try again. Remember, you must press S1 each time you test. A silicon diode will have a voltage drop of about 0.7V (1N914); germanium will be about 0.4V (1N34); Schottky 0.3-0.4 (1N5818); and any LEDs 1.4-2.4V. Your tester pulls about 10 mA, so if you have a data book you can check the forward voltage at 10 mA to determine what voltage to expect for a given diode type.

> ***"I checked a two-digit display on which I had no information and had all the pins identified in five minutes!"***

Seven-segment display testing

In testing seven-segment displays you'll find one of two types: common anode or common cathode (see **Fig. 4**). The key here is to locate the common lead. If you are working from a schematic then look for a "+" connection for a common anode and a ground "-" connection for a common cathode.

If you don't have a data book you'll have to guess, but that's easy. Common anode displays usually use pins 3 and 14; common cathode displays usually use pins 1 and 6. This is a good place to start.

If your deduction indicates that the display has a common anode then connect the "+" lead to the common pin or the lead you suspect to be common, and attach the "-" lead to any of the remaining pins. Press S1. If no segments turn on move the "+" lead to each lead, pressing S1 after each connection. Once you get a segment to turn on you have found the common lead. Keep the "+" connected where it is and move the negative lead around until all the individual segments come on one at a time. If you have a common cathode then connect the "-" to the common lead and attach the "+" lead to any of the remaining pins, pressing SI each time. Make some notes to keep track of your progress. Remember, your LED Checker limits the testing current to a safe value so it will not damage a display.

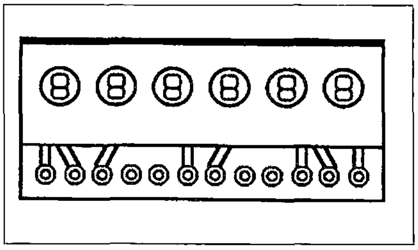


Fig. 5. A typical six-digit multiplexed display.

Multiple-digit display testing

Multiple-digit displays usually have common segments but have separate anodes or cathodes for each digit. You need to find all the digit pins as well as the segments. This is relatively easy and is done by noting what segment is on and what digit position it is located in. Make a drawing as you do the testing. I checked a two-digit display on which I had no information and had all the pins identified in five minutes! More complicated displays, such as that shown in **Fig. 5**, may take 10 to so minutes.

Well, that's about all there is to using the LED Checker Plus. Maybe you can think of some other unique uses and share them with the other readers!

A kit for the basic LED Checker Plus is available for $10.95, plus $2.50 shipping and handling, from Home Net, Box 49481, Blaine MN 55449. It's also available on Home Net BBS @6127559661.

SPECIAL EVENTS

Listings are free of charge as space permits. Please send us your Special Event two months in advance of the issue you want it to appear in. For example, if you want it to appear in the January issue, we should receive it by October 30. Provide a clear, concise summary of the essential details about your Special Event.

NOV 22–23

OCEAN SPRINGS, MS The West Jackson County ARC, Inc. will present a Hamfest/Swapfest at the Latimer Comm. Center, north of the city of Ocean Springs. Swap and Flea Market tables are $5 each, to be paid in advance. Mail table reservations to *WJCARC, P.O. Box 1822, Ocean Springs MS 39564*. For details, contact *C.F. Kimmerly N5XGI, (601) 826-5811*; or *Mike Gurley KC5QXE, (601) 475-6161, after 5 PM.*

DEC 1

HAZEL PARK, MI The Hazel Park ARC will sponsor their 31st annual Hamfest, 8 AM–2 PM, at Hazel Park H.S., 23400 Hughes St. Free parking. Reservations for eight-foot tables ($14 each) must be received with a check. No reservations by phone. Send payment to *HPARC, Inc. Swap, P.O. Box 368, Hazel Park MI 48030*. Talk-in on 146.640/443.225 DART Rptr. Six-foot tables available at the door for $10; limit one table per customer while they last.

DEC 7

GOLDEN VLLEY, MN The annual Courage Center Handi-Ham Winter Hamfest will be held at the Handi-Ham Headquarters, 3915 Golden Valley Rd., starting with registration at 8:30 AM. There will be a Handi-Ham equip. Auction, Flea Market, Dinner at noon, and Program. Contact *Don Franz WØFIT, 1114 Frank Ave., Albert Lea MN 56007.*

DEC 14

JACKSONVILLE, IL The Central Illinois Winter Superfest, sponsored by Illinois Valley ARC and Jacksonville ARS, will be held 8 AM–2 PM at Turner Jr. H.S., 664 S. Lincoln Ave. Vendor setup at 6 AM. VE Exams at 10 AM, pre-reg. required. Contact *Tim Childers KB9FBI, 773 E. College, Jacksonville IL 62650; Tel. (217) 245-2061*. Talk-in on 146.775(-), and 444.675(+). Advance reservations taken until Nov. 30th. Send SASE and check payable to *Jacksonville ARS c/o Kaye Green KB9KHQ, 27 Ivy Wood Drive, Jacksonville IL 62650.*

LAKE CITY, FL The Columbia ARS will hold its 2nd "Gateway to Florida" Tailgate/Hamfest at Robert B. Harkness Florida Nat'l. Guard Armory, 153rd Engr. Co., Lake Jeffery Rd. Call (904) 755-7969 for details. Talk-in on 145.490 (-), alternate 147.150(+).

SPECIAL EVENT STATIONS

DEC 6–DEC 7

MESA, AZ East Valley Amateur Radio Group, WA7USA, will commemorate the Battleship USS Arizona, from 1500Z–2400Z on 14.240 MHz and 21.340 MHz. Stations contacted may request a certificate by sending a QSL card and a 9" x 12" SASE to *EVARG, 3264 E. Carol Ave., Mesa AZ 85204-3245*

DEC 14

CHRISTMAS, AZ The TriCity ARC will operate from Christmas AZ in celebration of the Christmas season. Phone operations will take place from 1500 UTC–2100 UTC, on 7.225 MHz(+) and 14.240 MHz(+). Send QSL and SASE to the event callsign's *Callbook* address. Callsign to be announced.

DEC 14–DEC 15

NAZARETH, PA The Delaware-Lehigh ARC will operate W3OK (or possibly WX3MAS) as the Christmas Cities' Special Event Station. The station will be on the air 1400Z–0200Z from the twin Christmas cities of Nazareth, PA, and Bethlehem, PA. Freq.: 3.965, 7.265, 14.265, 21.365, and 28.365. For a certificate, send QSL and a 9" x 12" SASE to *DLARC, RR 4, Greystone Building, Nazareth PA 18064 USA.*

DEC 14–26

BELEN, NM The Valencia County ARA will operate KC5OUR 1800Z Dec. 14th–0000Z Dec. 26th to celebrate Bethlehem. (Belen is the Spanish word for Bethlehem.) A QSL card will be sent to all who provide an SASE. QSL to *KC5OUR, 93 Nash St., Belen NM 87002 USA.*

JAN 1997

GISBORNE, NEW ZEALAND The amateur fraternity is fast heading into a new century, with the year 2000 rapidly approaching. To acknowledge this event, the Gisborne ARC (Branch 11, NZART) will sponsor an annual international award, using the callsign ZL2000, until the year 2000. The award is open to all amateur radio operators and SWLs. To achieve an annual award, only one contact is required with a ZL2000 station during the month of January each year, until the year 2000. A special complimentary award will be issued to all stations that contact a ZL2000 station for four out of the possible five years, up to and including the year 2000. The fee for the annual award in New Zealand is $5, for Australia $5, and for the rest of the world US $10. Contact Gisborne 2000 Award, P.O. Box 1017, Gisborne, 3815, New Zealand.

What piece of ham gear would you most like to get for Christmas?

QRP

Number 80 on your Feedback card

Low Power Operation

Michael Bryce WB8VGE
2225 Mayflower NW
Massillon OH 44646

December already? Yes, it's true, 1996 is coming to an end. I sure hope the year was better for you than for me. Whatever I touched or did seemed to come apart this year. Let's hope 1997 is better.

Aside from the lack of sunspots, operating QRP has been an exciting hobby within ham radio. We've seen all sorts of new gear tailor-made for QRPers. Some of the gear is getting rather fancy compared to what we have become accustomed to.

Small thin film solar modules for QRP use

I've had several letters asking about soldering wires to thin film solar panels. These amorphous silicon panels have been turning up at surplus stores around the country. Some of the prices have been very attractive as well—but the downside is that there are no wires connected to the modules. In fact, when a thin film module is made, it can easily be cut up into even smaller modules, with only a glass cutter. This is what happens if the buyer gets a shipment of large modules. If the guy who does the cutting keeps the same amount of cells, the modules will always be the same voltage, but will generate small currents. The amount of current is dependent upon the physical size of the module.

Now, to make matters even worse, you just can't solder wires onto the glass substrate of a thin film module! In late August, I spent a week at Solarex in Frederick, MD. One of the first questions I asked was, "How do you solder wires onto the back of a thin film module?" Their answer? You don't. Here's the whys and the why nots of soldering to a thin film solar module.

The backside of the thin film module is made out of a substrate of either tin oxide or aluminum oxide. Both are deposited on the glass by flashing the material (let's say aluminum) onto the glass or in a plasma chamber. The coating is only several microns thick. So, with a material so thin, there's not much to hold onto.

Since we don't know what the substrate is made of we can try one (or both) of two methods. First, a silver solder, with a high content of silver, should work with the tin oxide substrate. The silver solder must have a very low melting point. If the melting point is too high, the tin oxide is burned away before the solder has a chance to stick.

If the silver solder did not work, then the substrate must be aluminum oxide. We can then try some aluminum solder. Right off hand, I don't know of a source for this stuff. The aluminum solder must also have a low melting point. You'll also need an adjustable soldering iron; you must lower the operating temperature of the tip to prevent burning off the oxide.

"A thin film module about the size of this magazine will produce about 3-5 watts under a full sun."

A cheap and dirty way to make your soldering iron so you can vary the tip's temperature is to use a lamp dimmer. You can get these from any home improvement center.

If, by chance, you manage to get the wires soldered, then you must protect the connections. Remember, there is not enough material for a strong joint. A coating of RTV or hot melt glue will be needed to secure the connections. With a lot of luck, you may be able to make connections to the backside of a thin film module.

If you do, then apply a film of RTV around the edge of the glass. Water will seep up into the active material if you don't. Solarex prevents this by using a laser to burn off a strip of active material all along the edge of the thin film module. This effectively isolates the active material from the glass edge.

A thin film module about the size of this magazine will produce about 3-5 watts under a full sun; combining this module with a small gelled lead acid battery will power most of the single-band QRP rigs on the market. See my Micro "M" portable charge controller in the September issue of *QST* if you want a charge controller for your portable station.

"This power supply will produce 12 volts at 1.5 amps, and it costs only six bucks."

Low-priced power supplies

I'd guess most QRPers have access to several sources of power for their rigs. If not, and you don't want to home-brew one, I have found several that will power a QRP rig. The best part is the price. These power supplies are surplus and were made to power laptop computers.

Many of these supplies are of the switching type. I'm not sure if the switching noise would get inside a direct conversion rig or not. Perhaps, but you should have no trouble running a superhet rig with one.

Hosfelt Electronics (800-524-6464) has several units that look good. One in particular is a tiny guy who measures only 6 by 2 inches. It will produce 12 volts at 1.5 amps. Best of all, it's only six bucks. Its stock number is 56-448. For $10 you can get one that produces 18 volts at 1.4 amps (40-140), ideal for battery charging. By adding on an external three-leg regulator you would have the basics for an adjustable power supply.

If the switching noise is getting into your rig, then Hosfelt has a linear supply that produces 12 volts at 3.4 amps (40-176) for $25.

DX news for QRP ARCI

Dick GØBPS has resigned as the UK rep for the QRP ARCI. What does this mean to you? If you live outside the USA or Canada you must now send your renewal fees directly to me and not to Dick. It also means we have to rethink the way you send your funds.

First, the QRP ARCI does not accept credit cards. Second, I know the price of getting an international money order often exceeds the price of the dues. So what's a ham to do? Send cash.

Yup! I know, I've said it, they've said it, even your mother said it: Do not send cash in the mail. However, you can send cash if you follow these simple steps.

First, do not put my callsign or your callsign on the letter. You want the letter to look as generic as possible. Second, do not address the letter to QRP ARCI. Address the letter to me. Do *not* send the letter certified or requesting a signed return receipt. Remember, you want the letter to look just like one you would send to dear old Mom. Are you going to send *her* one by certified mail? I think not! If you want an acknowledgment of your letter and money, enclose a mailing label and first class unit of postage inside your letter. IRCs are fine if you have some lying about.

Wrap your money in either carbon paper or aluminum foil. This prevents prying eyes from seeing the money through the envelope. If possible, use large bills instead of singles or fives. A twenty and a five will mail cheaper than five fives. Some of the postage rates are incredible, one reason why the QRP ARCI has raised the DX dues to $25 a year for airmail delivery.

For all members of the QRP ARCI, I've moved. The new address is:

QRP ARCI
P.O. BOX 508
Massillon OH 44646

ABOVE & BEYOND

Number 81 on your Feedback card

VHF and Above Operation

C. L. Houghton WB6IGP
San Diego Microwave Group
6345 Badger Lake Ave
San Diego CA 92119
Internet: clhough@aol.com

Now that we have built several converters and covered them in quite a bit of detail, I am ready to put the cart before the horse, so to speak, and discuss IF system operation. I admit that I did not plan to cover this aspect of microwave operation because it just didn't *occur* to me before.

I have been an amateur for a good number of years and have accumulated quite a pile of material that I draw upon to construct projects. I've been known to take an existing complete radio which has fallen into disuse and construct something inside it, changing the main function completely.

Back then, when radios were not quite as small as today's devices, there was plenty of room to construct adjuncts into a radio case, changing the rig's operational point of view while retaining the beauty of the original product. Take, for example, one of my early converters, constructed to replace my 2 meter transmitter and separate receiving converter. At that time I was using a tube-type transmitter for 2 meters that was crystal-controlled on 145.5 MHz (AM) and ran with three 6AQ5 multiplier tubes and a single 6C4 oscillator. You might point out that the 6AQ5 was an audio amplifier. I agree, but it worked. The receive converter was a premium crystal-controlled downconverter from 144 MHz to 14 MHz for the IF frequency.

"Sometimes you eat the bear—and sometimes the bear eats you."

The main shack VHF receiver was a National NC-303, about the size of an apple box. The plan was to take a recent surplus Heathkit 20 meter single-band transceiver and convert it to 2 meters. I was able to pick it up for minimal cash output as parts were missing and it was unfinished. Well, to make a long story short, I removed the high power parts and finished the transceiver (20 meter), then mounted the 144 MHz converter and a transmitter from a salvaged Gonset transmitter for 2 meters. This new transmitter, though still crystal-controlled, used a 2E26 final and put out 5 watts (AM).

All this was stuffed into the Heathkit 20 meter monobander. This project gave me a deluxe 2 meter station (and the beginnings of 2 meter SSB operation), using mostly scrounged junk. This was my start with VHF and the late '60s/early '70s construction. My tool collection included a round rasp file and rattail file to round out holes drilled on the back porch to hold tube sockets, meters and such. Quite a humble start.

I think back to those days and the enjoyment and struggle that I went through to put together what I consider quite easy today. How much time I could have saved if I'd had a better grasp of technical details and math applications! Today, with a computer at my home and model simulation at my fingertips for circuits that were bench-top struggles then, I can make vast improvements, even using a slow 286 IBM mainframe.

Yes, I still have a 286, and even some old CPM machines that still function. They sit next to my 486 super-duper speedster. I guess it's always speed and performance for the assistance of man, but I still retain the slower, more comfortable old shirt and blown-out tennies for when the mood strikes.

Well, there you have some of my deep dark projects of years gone by. The ideas still have a familiar ring; only the tune has changed a bit. Today we build converters into cases that seem to suit the material and retain the IF system outside the environment of the converter. This is because the IF system is in plentiful supply due to the very heavy use of 2 meters and multimode rigs.

Sure, some of these rigs are old by today's standards of CTCSS tones and two or more synthesized VFO oscillators or programmed frequency entry. Don't be fooled by the expensive price tags on the newest rigs and let that prevent you from using a simpler version of the same radio. Look in the used market for a suitable unit that might not have all the newest bells and whistles. Used equipment stores and flea markets may provide an IF system that can be applied to microwave converter use.

A bargain can be had, especially if you purchase a blown or defective radio that might have a high power transistor amplifier stage destroyed. Don't tell the person you are haggling with that this is just what you desire, as you don't need a power amplifier in your IF system radio. (*My Rule #1: I disable all power amp stages as it is not a requirement in converter use.*) A low power output in the 100 milliwatt range is ideal as you still need to reduce it to +10 dBm from this power level.

At the 100 milliwatt power range (100 mW) we still need a small value of attenuation to reduce power for input to a microwave mixer. While there are mixers that will handle 100 mW +20 dBm of power, most prefer +10 dBm. Converting power in watts to dBm might seem a little intimidating at first but it is quite easy if you know a couple rules of power. The main rule is that every power change in watts that doubles or divides by two results in a 3 dB change in power. A 10 watt radio output power is the same as stating your radio outputs power of +40 dBm; 10 watts and +40 dBm are the same power level, just stated differently. Now subtract 3 dB from the +40 dBm level: -3 dB = +37 dBm = 5 watts of power. Keep going and the following is true: +34 dB = 2.5 watts, +31 dB = 1.25 watts, +30 = 1 watt, +27 = .5 watt and +20 = .1 watt or 100 milliwatts.

Why use a 30 dB attenuator to reduce a 10 watt transceiver power to +10 dBm for input to a mixer? Yes, it can be done, but you're wasting a lot of battery power in portable operation and giving it up as heat with no useful application. The same transmitter with the power stage removed or disabled can be put to much better use with less drain on portable batteries.

Rule #2: My used 2 meter transceiver doesn't have any repeater tone control built into the radio. Well, this is a benefit again because the CTCSS tone and repeater subaudible tones are not used on the microwave bands. Details like this make the radio somewhat high on the priority list to be replaced from a repeater operator's point of view. Many amateurs will take this older equipment's used value in trade towards the purchase of newer transceivers. This is where the microwave land sharks come into play, trying to locate these older transceivers, especially the units capable of SSB operation.

Where can you find these transceivers capable of SSB operation? Well, try your local flea market and ham club swap meets. Do what the big guys do—advertise. Use a small file card on your club bulletin board or at your local ham radio store's courtesy bulletin board. Mention your wants during various net activities on the air. You will never know how successful you can be until you try some of these methods.

My successful finds

Some of the rigs that meet the multimode 2 meter plan of attack include the Santec LS-202, ICOM IC-202, IC-245, IC-260 and Yaesu FT-480. All of these radios are 2 meter capable and have SSB operation, and some have FM and CW. The LS-202 is a handie-talkie and a multimode miniature transceiver with SSB, upper and lower SSB, CW, and FM, in a pack with 8AA batteries. Its detriment is that the knobs are quite small, but it performs well in any mode of operation.

I obtained this radio as a basket case junker with no power transistor, driver, and a busted audio potentiometer, and it arrived in 10 pieces. It wasn't *that* bad as most of the wiring was still in place because it had been disassembled for repairs that were never made. It sat in someone's junk box for quite a few years until I asked the question, "Got any multimode rigs?" It was brought out and I bought it. The seller would have never thought about selling it, and was almost not going to sell it because it was in such bad shape. But I insisted that I was willing to take it without any guarantees. That satisfied the seller, relieving him of any obligation. That was some six years ago and since then that radio has operated well, with only three other trouble/repair scenarios. These were completed and it's still working today as my smallest portable multimode radio.

You might think me crazy because of some of my other choices. I obtained an IC-245, with an SSB/CW adapter, that had driven its owner nuts with drifting VFOs and intermittent operation. In a chance encounter he offered it to me for $5, so he could be rid of the dreadful device.

Well, my first ICOM radio was an IC-211 that had similar problems, and this IC-245 was a mobile version of that same radio. The circuitry problems that I troubleshot over several years on the IC-211 related to the plated rivets used to connect the top and bottom PC board traces. They became flaky in the conductivity department with time, even with soldering, and would go open. (The fix put a wire through the rivet and bond to top and bottom trace of the PC board.) Having spent a bunch of time to repair the IC-211 (a repair job approaching an act of love), you could say I got a real education on very early ICOM radios. I applied the same fix to the IC-245 that I had used for the IC-211.

"Don't attempt to repair an expensive piece of equipment before doing your homework."

Standing now on familiar ground (the IC-211 and the IC-245 synthesizer are exactly the same), I grabbed the file with my repair notes on where all the solder rivets were on the synthesizer chassis, and other shortcut fixes I used in repairing the IC-211, and installed the standard fix to the IC-245. I put the covers back on and applied power, and I lucked out! It worked right off the bat. It has one related idiosyncrasy that I am still trying to fix but that is intermittent—it only happens about twice a year.

Would everyone tackle such a project? Well, we will never know the answer to that one, but if you should choose to attempt such a task it can only reap rewards. This reward might only be increased technical awareness—but be patient and don't spend a lot of money to only tempt fate. Be prudent and improve your troubleshooting and repair skills using inexpensive items to work on at first. Don't attempt to repair an expensive piece of equipment before doing your homework. Build up to the experience level needed to work on a complex piece of equipment. You'll improve with time.

What was the disposition with the Yaesu FT-480 multimode rig? It was purchased at a swap meet from an unfamiliar person and was advertised to be in good shape and tested. Well, the price dropped when there was no mike or power cord to be had, nor any manual. This to me meant the radio was in very dubious condition and unchecked. With my hand still on the unit, and alert for other bargain-hunters, haggling commenced. Soon a mutual price was worked out and it was mine.

I took it home and made a power cord and mike, turned it on, and the receiver was dead. No audio at all, with or without the squelch ... nothing. The frequency dial responded OK so I tried transmit in low power and it worked well and on frequency. Looking at the chassis, which had a very tightly-packed component high-density construction, I opted to order the manual and schematic before beginning surgery. The manual was very reasonable—$20—and available from Yaesu (my hat's off to Yaesu and their excellent service department).

I received the service manual and in the troubleshooting guide there was my exact trouble condition as trouble #1. The fix? Replace a dirty miniature relay contact used to switch a DC voltage between the transmit and receive control circuits. Three minutes to fix the radio and 10 minutes to put the covers back on. It had been a simple problem, but a hard one to locate without the manual. Sometimes you eat the bear—and sometimes the bear eats you.

In retrospect, I guess I got eaten by the bear in my dealings with my IC-211 repair job and pulled off a reverse on the LS-202 and the IC-245. It takes persistence and application and the willingness to overcome repair obstacles to extract a bargain from surplus or swap meet sources. Have I ever received perfect equipment from swap meet sources? Absolutely! An IC-260 multimode 2 meter rig in perfect shape. Don't cast doubt on everything, just examine it

carefully instead of letting emotion run the purchase.

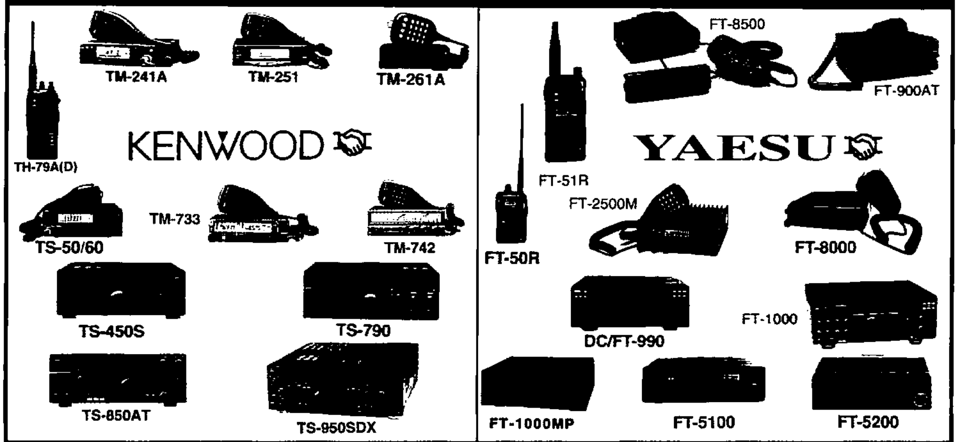
The 2 meter IF system

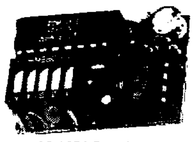
What is the best attribute of the radios I have described so far, and what improvements would I suggest? Well, by using a 2 meter IF system for your microwave converter you have the ability to utilize its different modes of operation: SSB, CW, and narrowband FM. Additionally, you have an accurate frequency dial to amble about your converted microwave frequency, usually the selected converter frequency plus 4 MHz of tuning range.

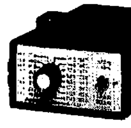
If you were operating at 5760 MHz and using a 144 MHz IF then you can span the 5760 MHz to 5764 MHz tuning range on the IF system at 2 meters via the converter. This gives you a great receiving and transmitting system by allowing the IF system to basically run the show. Allowing for transmitter power reduction or disabling the power stage is a must for converter use. Also, a point to consider is the frequency control knob on most of these transceivers I have described. With the exception of the IC-211, all have detent-type harsh tuning for frequency control of the 2 meter radio.

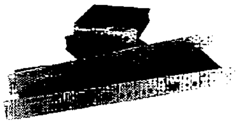
I wish some of the manufacturers would take heed and produce a radio capable of making the transition from a multimode transceiver with power and sensitivity to a low power converter mode device. There should be some means to shut off the power stages and bypass them for low power output, not switched low power. Having a switch that changes power level is not prudent to run switched low power into a microwave converter. While this option will work, it can destroy the converter's low power input mixer and other circuitry if the power switch is accidentally bumped or operated. It is better to have a fixed hard pulled-down low power conversion that will not harm a sensitive expensive microwave mixer.

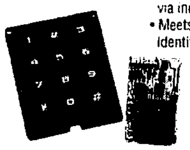
Well, that's it for this month and this year. I hope you and yours have a very Merry Christmas and a Happy New Year. Best 73 Chuck WB6IGP.

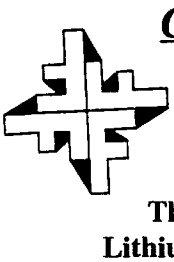












NEW PRODUCTS

Number 84 on your Feedback card

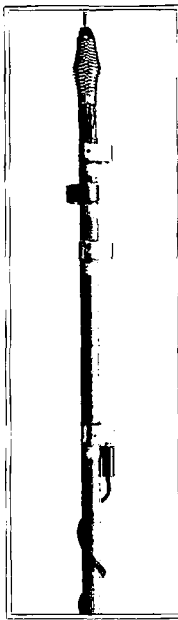
Perfect Stocking Stuffer

Alinco Electronics introduces the DJ-S41T, a handie-talkie transceiver that operates on the 70 cm (440 MHz) band. It's only slightly larger than most pagers, runs on three AA batteries, and it's priced under $150 at most Alinco dealers.

At a price nearly everyone can afford, the DJ-S41T features 21 non-volatile memories, CTCSS encoder, offset capability up to 15.995 MHz, and transmits with a power of 340 milliwatts, more than adequate to hit repeaters or carry on simplex communications over a considerable distance.

The DJ-S41T has a pivoting "swing up" antenna, keeping the radio compact enough to carry in purse or pocket, on a belt like a beeper, or in a kid's backpack; and if you don't have to detach the antenna, you probably won't misplace it. The universal reaction when people try out the DJ-S41T is "How can I get one?" Find out for yourself at your nearest Alinco dealer.

Slimline Mobile Antenna



Palomar Engineers announces a new slimline mobile antenna for the 75, 40, 20, 15, 10, 6 and 2 meter bands. The AN-7's Fiberglas™ base section is four feet long with a spring protected three-foot whip on top. Change bands by selecting taps on the helical base coil. The AN-7 was developed by Antronic, a major South African manufacturer, and has been in use in the South African bush country for years—it is now available in the United States for the first time.

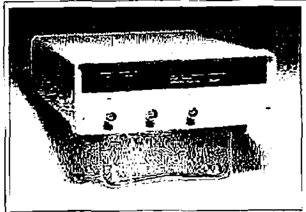
The complete antenna weighs only two pounds and presents a very small wind-loading area. Its discreet size and attractive finish make it suitable for use where other antennas would not be permitted, and it's priced at only $249.95.

For more information, contact Palomar Engineers, P.O. Box 462222, Escondido CA 92029. Telephone 619-747-3343, FAX 619-747-3346, or E-mail 75353.2175@compuserve.com.

Affordable DSP — to Go!

Kenwood's new TS-570D HF transceiver offers the world's first CW Auto Tune feature, which eliminates VFO adjustments during CW operation. The TS-570D also has a Radio Control Program that will be available for operators to design and program multiple radios with custom settings while conventionally saving them to a file for future use.

If you've been waiting for a DSP (Digital Signal Processing) HF radio that'll fit into your budget, check with your authorized Kenwood dealer for details, so you can enjoy the TS-570D, destined to take its place alongside other world-renowned Kenwood rigs like the TS-50S.



Atomic Clock Accuracy

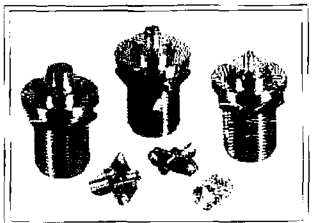
Novatech Instruments, Inc. introduces the Model 2955AR Rubidium Standard with Synthesized Output. It has a direct digital synthesizer output that is 32 bit programmable from 10 Hz to 4 MHz, and fixed outputs of 10 MHz and 1 MHz. The 2955AR contains an Atomic Resonance Rubidium Oscillator and has long-term stability of better than $5x10^{-11}$ per month and short-term stability of better than $0.7x10^{-11}$ in 10 seconds.

There's an EEPROM memory in case of power shutdown, and it's ideal for use in communications system applications since the 2955AR can be set to standard frequencies such as the 1.544 MHz T1 frequency. Of course, it's also perfect for laboratory and ground station use, as a master oscillator, as well as for tests and calibration, and the 2955AR is attractively priced at $4,295. You need one. Yes, you do. Check out the specs on the web site at http://www.eskimo.com/~ntsales, or write Novatech Instruments at 1530 Eastlake Avenue East, Suite 303, Seattle WA 98102.

Sunspot Cycle Got You Down?

Down on the lower HF bands, that is? Bilal Company may have the answer for acreage-challenged hams who want to work the 160 meter band. Many conventional HF antennas require lots of space—but the new Isotron 160C is under 10 feet tall and mounts on a conventional mast. This resonant antenna requires no radials, is tunable and can be set for a preferred portion of the band.

You'll be impressed by the Isotron 160C's transmitting and low-noise receiving performance; and it's only $159.95. For more information about the Isotron antenna line or a free catalog, contact: Bilal Company, 137 Manchester Drive, Florissant CO 80816.



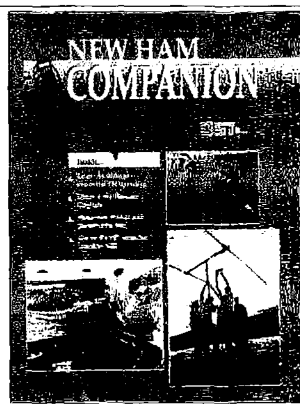
Connectors

RF Connectors has released two series of connectors for semi-rigid cables. Rear-mount N female bulkhead connectors are available to accommodate .086, .141, and .250 cables. SMA plugs, bulkhead jacks and two-hole and four-hole panel mount jacks are available for .086 and .141 cables. Connectors feature Teflon™ insulation, gold contacts, and nickel or gold plating.

The connectors are available from RF Connectors distributors throughout North America. For additional information, specs, and availability, call 800-233-1728 or E-mail: 102061.2261@compuserve.com.

It's Worth It

New Ham Companion from the ARRL. With the League membership growth stagnant, and the only significant growth in the hobby being the no-code licensees, the League has addressed this group with a 64-page booklet (about half of it is ads). It explains how repeaters work, about packet, antennas, satellite contacts, learning the code and low-cost low band QRP. You get your $2 worth.



Spiffy Free Catalog

Time Motion Tools has released its new 172-page catalog of tools—and it's full of cool toys: hand tools, power tools, lighting and magnification tools, all kinds of meters, including the new Fluke 7-300 and other Fluke meters. If you haven't yet got hold of this one, write or call Time Motion Tools, 12778 Brookprinter Place, Poway CA 92064. Phone (800) 779-8170, FAX (800) 779-8171; or visit their web site at http://timemotion.com.

Get More Ladders!

Cable X-Perts, Inc. announces two more ladder line cables—the 300 Ω ladder line cable and the 14ga 450 Ω ladder line cable. These balanced transmission cables provide low loss attenuation across the HF (>30 MHz) bands. Prices start at 100 feet and up—0.13/ft for the 300 Ω version and 0.25/ft for the 14ga 450 Ω version—discounts apply at 500 ft and 1000 ft quantities. For more information and other special offers SASE to: Cable X-Perts, Inc., 416 Diens Dr., Wheeling IL 60090. Phone orders only (800) 828-3340, or E-mail: cxp@netcom.com.

CAT Got Your Code?

Computer Aided Technologies announces the Code 3-Gold, a new VHF and shortwave decoder that uses the best of software detection technology and the latest in miniaturized electronics for the hardware interface.

Systems supplied as standard include packet, BAUDOT, SSTV, NAVTEX, PACTOR, and more. For further information, contact Computer Aided Technologies at P.O. Box 18285, Shreveport LA 71138, or call (318) 687-2555. Internet users can contact the company on the WWW at <http://www.scancat.com>.

It's Like Being There

Pacific-Sierra Research Corporation offers a guided Internet tour of their new HFx software, which provides quick, easy accurate propagation predictions. HFx calculates ionospheric signal strength from 2 to 30 MHz, using an intuitive Graphical User Interface. The central feature is the HFx Interactive Map, which can display the subsolar position, day/night terminator, the great-circle path between transmitter and receiver, major cities, and the high-latitude auroral ovals. Just click the mouse!

It's designed especially to be easy enough for beginners to use, and thorough enough for experts, and it's only $129 postpaid worldwide—check it out at the HFx home page: http://www.psrv.com/hfx. For more information or to order, contact HFx - Dept. 73, Pacific-Sierra Research Corporation, 2901 28th St., Suite 300, Santa Monica CA 90405-2938, USA. Phone (800) 820-4PSR; outside US and Canada (310) 314-2346; FAX (310) 314-2323.

Orchid City's Newest

Orchid City Software has completed the Voyageur v1.1 Radio Database for DOS, a comprehensive suite of database programs for broadcasting radio stations' information gear toward the radio DXer and listener. You want to know what's going on in the DX/SWL world? Here's a list of DX/SWL program schedules. Find any program by the day of the week, time of day, station, etc. You've got a program for writing log reports and printing in a number of formats—type it once and print multi formats. Schedules, frequencies, addresses, radio station slogans—in English, Spanish, Indonesian, French, Portuguese, and more!

The Voyageur v1.1 already contains thousands of records and is completely read/write: it can be updated, changed, or added to easily. To order your copy send $29.95 to Orchid City Software, P.O. Box 18402, West Palm Beach FL 33416. Overseas orders add $10.00 for additional postage.

Radio Bookshop

Phone 800-274-7373 or 603-924-0058, FAX 603-924-8613, or see order form on page 88 for ordering information.

Great ARRL Books!

AR1086-4 **ARRL Operating Manual** Information on how to make the best use of your station, including interfacing with home computers, OSCAR, UHF-VHF. $22.00

AR4173 **Now You're Talking! All You Need To Get Your First Ham Radio License**–A complete study guide for the Technician and Novice written exam. Practical information every beginner needs is written clearly and simply and in small doses. $19.00

AR4734 **ARRL Antenna Book.** Best and most highly regarded info on antenna fundamentals, transmission lines, design, and construction of wire antennas. $30.00

AR4971 **ARRL Repeater Directory 1996** Over 19,000 listings with digipeaters, bandplans, CTCSS (PL(TM)) tone chart, frequency coordinators, ARRL special service clubs, and beacon listings from 14MHz to 24GHz. $7.00

AR3177 **ARRL Spread Spectrum Source Book** From a deceptively simple beginning, a group of experimenters set out to develop first theoretical and later practical systems for spread spectrum communications. This book consists of articles, papers and government reports that document the process whereby amateur spread spectrum progressed from the drawing board to the airwaves. $20.00

AR3851 **Hints and Kinks** Ideas for setting up your gear for comfortable efficient operation. $10.00

AR3185 **The Satellite Experimenter's Handbook** by Martin Davidoff K2UBC Expanded and revised. Focusing on satellites built by and for the international radio amateur community $20.00

AR4645 **Satellite Anthology** The latest information on OSCARx 9 throu 13 as well as the RS satelittes, the use of digital modes, tracking antennas, RUDAK, microcomputer, and more! $10.00

AR4483 **Weather Satellite Handbook** by Dr. Ralph Taggart WA8DQT. Expanded and revised to reflect today's weather-fax satellite technology. $20.00

AR4653 **Companion Software for Weather Satellite Handbook** 5-1/4" MS-DOS floppy $10.00

AR2973 **Complete DX'er** by Bob Locker W9KI Learn how to hunt DX and obtain hart-to-get QSL cards. $12.00

AR0402 **Solid State Design** Good basic information, circuit designs and applications; descriptions of receivers, transmitters, power supplies, and test equipment $15.00

AR4661 **ARRL's Antennas & Techniques for Low-Band DXing** can be your ticket to low-band success. $20.00

AR1996 **The ARRL 1996 Handbook** includes the latest innovations in ham radio, plus all the fundamental data. $38.00

Books for Beginners

TAB4354 **Beginner's Handbook of Amateur Radio** by Clay Laster W5ZPV. 395 pages. Wonderful book for newcomers. It is basic and well illustrated. Even if you have all the other ham handbooks, you'll still find this one useful. $22.00

W5GWNV **No-Code Video, Manual, Part 97 Rules** by Gordon West Learn how to be a ham radio operator $29.95

W5GWNC **Technician Class License Manual: New No-Code**–by Gordon West This book covers everything you need to become a Technician Class Ham. Every question and answer on the examination is found in this one book. FCC Form 610 application. $9.95

Antenna Books

UE220 **The Easy Wire Antenna Handbook** by Dave Ingram K4TWJ. All of the needed dimensions for a full range of easy to build and erect "sky wires." $9.95

WGP87034 **All About Cubical Quad Antennas** by William Orr and Stuart Cowan "The Classic" on Quad design, theory, construction, operation. New feed and matching systems. New data. $13.95

TAB3270P **Practical Antenna Handbook**–2nd edition by Jos. Carr. This 560-page book is a treasure. Starts with fundamentals, explains propagation of all kinds, and provides a ton of easy antenna projects. $26.95

WGP87077 **Simple, Low-Cost Wire Antennas For Radio Amateurs** by Willliam Orr and Stuart Cowan. Low-cost, multi-band antennas; inexpensive beams, "invisible" antennas for hams in "tough" locations. $13.95

Mobile or Chairside HT Holder

A simple, practical project based on a boat accessory.

Peter L. Barker XF1/KB6ASH
La Jolla de Los Cabos AB-506
San Jose del Cabo
B.C.S. 23400 Mexico

My other hobby besides amateur radio is sailing. As with ham radio, many "cute" products are developed for that market. One of the best-known is an ashtray mounted on a small beanbag so that it can be safely used on a boat in motion. I was looking at this one day and it occurred to me that this simple idea could be applied to a holder for an HT on board, in the car, or even by the favorite chair at home. Like many simple ideas, creeping elegance set in and the project soon started to mushroom into a universal holder. Eventually common sense prevailed and I came up with the idea described here. Even if you don't have a wife who is a talented seamstress, as I do, this project should be within the capability of any determined "putterer."

Make a simple bracket in the shape of an acute-angled "L" from aluminum, Plexiglas™ or thin plywood. Choose the size and angle to suit the radio and the desired operating position. The length of the foot of the "L" should be at least half the length of the long side.

The "beanbag" can be made of almost any material or fabric that is not slippery. The "beans" (or in my case, sand) are poured into a locking plastic bag and slipped into the beanbag. The bottom of the "L" is inserted into a pocket sewn onto the outside of the top layer of the bag. The bag is then folded over to sit with the weight of its contents resting on the foot of the "L." If the material used to form the "L" proves to be too slippery to allow the belt clip to hold the HT securely, a piece of thin rubber, such as inner tubing, or fabric can be glued on with contact cement to provide added friction. Alternatively, an elastic band can be slipped over the "L" and the radio.

I have used this simple support successfully on a heeling sailboat, in a bouncing Bronco (Ford type!), and next to my TV chair.

Oh, the creeping elegance... pocket for speaker mike and spare battery pack, a dual-radio model, Velcro™ closures, cable strain relief, etc.

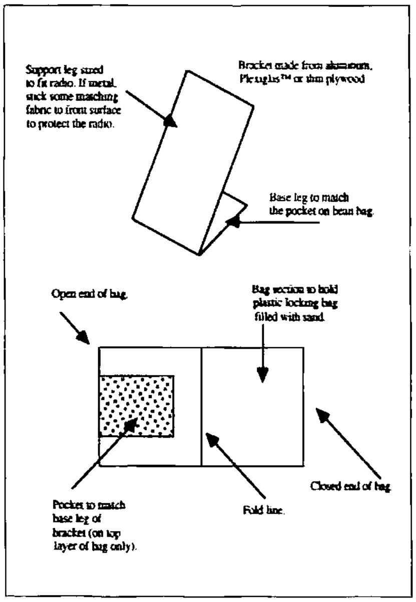


Fig. 1. Beanbag mobile HT holder. A) Bracket. B) "Beanbag," made of denim or light canvas.

PROPAGATION

Number 87 on your Feedback card

Jim Gray W1XU
210 Chateau Circle
Payson AZ 85541

Radio propagation on the HF bands this month suffers from seasonal lows combined with low solar flux values near the bottom of sunspot cycle 22, although there is hope for substantial improvement during 1997. In general, QRN will be low and the bands quiet.

The best days are expected to be the 2nd–5th, 9th–12th, and 14th–17th. The worst days are expected to be 6th–8th, 18th–23rd, and 27th–29th. Use the accompanying calendar to guide your operations. There may be some intensive geophysical effects felt on or around the 20th and 21st, possibly ionosphere/atmosphere-related, earth-related, or both. Stay alert and prepared.

EASTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA							20	20				
ARGENTINA	20	40	40	40	80	80				20	15	15
AUSTRALIA	20		20		40	40	20	20			15	15
CANAL ZONE	15	20	20	40	40		20	20	15	15	15	15
ENGLAND	20	40	80	40	40		20	20	20	20	20	20
HAWAII	20		20		40	40	80	20			15	15
INDIA	20					20	40	20				15
JAPAN	20						20	20				20
MEXICO	15	20	20	40	40		20	20	15	15	15	15
PHILIPPINES							20					
PUERTO RICO	15	20	20	40	40		20	20	15	15	15	15
SOUTH AFRICA			40	40				15	15	15	20	20
U.S.S.R.	40	80	80	40			20	20	20			40
WEST COAST		80	80	40	40	40	20	20	20			

CENTRAL UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA						80	40	20				
ARGENTINA	20		40	40	40						15	15
AUSTRALIA	15					40	20	20	20			15
CANAL ZONE	20	80	40	40	40	40	20	20	15	15	15	20
ENGLAND	40	40	40	80				20	15	20		40
HAWAII	15	20			40	40	40				15	15
INDIA	15	20	20				40	20	20			
JAPAN						80	40	20				
MEXICO	20	80	40	40	40	40	20	20	15	15	15	20
PHILIPPINES								20				
PUERTO RICO	20	80	40	40	40	40	20	20	15	15	15	20
SOUTH AFRICA	20	40							15	15	20	20
U.S.S.R	40		40	40				20	20			

WESTERN UNITED STATES TO:

GMT:	00	02	04	06	08	10	12	14	16	18	20	22
ALASKA	15	20			40	40	40	40	40			20
ARGENTINA	15	20		40	40	40	40	40		15	15	15
AUSTRALIA	15	20	20				40	80	40	15	15	15
CANAL ZONE	20	20		40	40	40			20	15	15	15
ENGLAND			80	40					20	20		
HAWAII	15	15			20	20	20	20				15
INDIA		20										
JAPAN	15	20			40	40	40	40	40			20
MEXICO	20	20		40	40	40			20	15	15	15
PHILIPPINES	15	20					40	40		20		20
PUERTO RICO	20	20		40	40	40			20	15	15	15
SOUTH AFRICA	20	40	40							15	15	20
U.S.S.R.		40	40	40	40				20	20		
EAST COAST		80	80	40	40	40	20	20	20			

DECEMBER 1996

SUN	MON	TUE	WED	THU	FRI	SAT
1 F	2 F-G	3 G	4 G	5 G-F	6 F-P	7 P
8 P-F	9 F-G	10 G	11 G	12 G-F	13 F	14 F-G
15 G	16 G	17 G-F	18 F-P	19 P	20 P-VP	21 VP-P
22 P	23 P-F	24 F	25 F-G	26 G-F	27 F-P	28 P
29 P-F	30 F	31 F-G				

10–12 meters

A few possible daytime F2 layer openings to South and Central America on the Good (G) days.

15–17 meters

Fair DX openings on Good (G) days between noon and sunset, and short-skip openings during the daylight hours. The band dies at sunset.

20 meters

DX to most areas of the world during daylight hours, peaking a few hours after sunrise and again during the early afternoon. Although the band usually closes soon after sunset, you may find occasional openings to South America and Antarctica until midnight. Daylight short skip from several hundred to 2,000 miles or so possible on most Good (G) or Fair (F) days.

30 meters

DX toward the Europe in the late afternoon and evening on Good (G) days until midnight, and then toward the Orient in the early sunrise hours. Possible long-path DX in the morning and also short skip most days out to a thousand miles or more, and farther in the evening.

40 meters

DX toward Europe and Africa in late afternoon hours, toward South and Central America around sunset, and good openings to the West and South Pacific peaking around sunrise on Good (G) days. Expect daytime short skip to 1,000 miles, and 2,000 miles at night.

80–160 meters

Both are excellent bands for DX during hours of darkness, peaking at midnight and just before dawn. Daytime skip on 160 is nonexistent, but on 80 it can be up to 500 miles, and over 2,000 miles at night. On 160, short skip can reach from 1,000–2,500 miles at night. Experts prefer vertical polarization for transmitting antennas (low-angle signal take-off) and horizontal polarization for receiving antennas (less noise) on 160 meters.

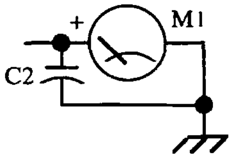
Don't forget to listen—even on the worst days—as you may be pleasantly surprised; also, now and then CQ into a seemingly "dead" band for the same reason. W1XU. 73

UPDATES

Speaking Frank-ly about corrections...

"A Versatile QRP Random-Wire Antenna Tuner," Oct. '96, page 21: In the sixth paragraph in the first column, a line reads "... from wiper terminal 1 of S1..." It should read "... from wiper terminal of S1..."

Fig. 1 on page 19 seems to have been cut off (just like the tops of my family's heads when I take vacation photos). This is the ground that was missing:

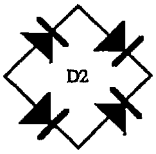


And please check the Parts List; there are two corrections to be made to it. The first is that the "Toroid FT50 43 (L1)" listing should be deleted because it is redundant. Secondly (and lastly), please pencil in a 3 in the T1 listing so that it reads, "6 turns AWG-22 on FT37-43 core (see text)."

Once again, our apologies to Mr. Brumbaugh.

An economical high current mistake.

Fig. 4 of "Economical High Current Power Supply" on page 52 of June's issue contained a full wave bridge labeled D2. Half of it is backwards. Here's how D2 should look:

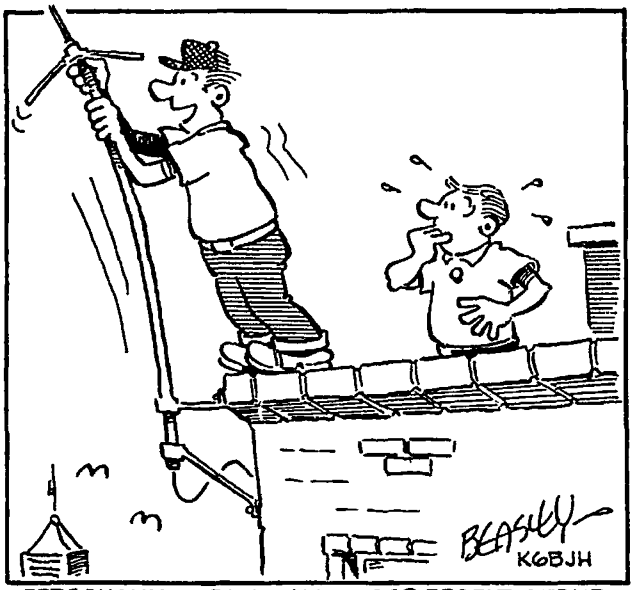


73

→ How you can get the ham gift(s) you've always wanted ... and didn't know how to ask for:

Circle this arrow!

1. Read this issue cover to cover (including all the ads).
2. Circle the item(s) you wish you had in your ham shack.
3. Show this marked issue (turned here with arrow circled) to your gift-for-you-buyer (who will actually welcome your subtle suggestions as they don't need the frustration from wasting time and money getting you something you don't really want when it's so easy to make you happy).



PERSONALLY, I THINK ALL THOSE PEOPLE AFRAID OF HEIGHTS ARE JUST PLAIN COWARDS!